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of Bob Veal.

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THE DIGESTIBILITY AND DECOMPOSABILITY OF BOB VEAL

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Department of Veterinary Physiology

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THE DIGESTIBILITY AND DECOMPOSABILITY OF BOB VEAL.

PIERRE A. FISH.

Department of Veterinary Physiology.

When the work on bob veal was undertaken some four years ago, it was desired especially to ascertain if it might be possible to differentiate with some degree of accuracy between the tissue of so-called immature or bob veal and that of market veal. In previous papers* records have been published of the work as it has progressed and the purpose of the present paper is to complete the data gathered since the previous publications and to record the results of some experiments upon the digestibility and decomposability of the tissues of the bob veal as compared with those of the market veal and beef. While it is regrettable that the idea of the digestion tests did not occur to us at the beginning of the investigation, the data which have been obtained are sufficient for comparison. Twenty-two samples from the round and loin of the bob veal and from 15 to 18 samples from similar parts of the market veal and beef or a total of 110 samples were used in the experiments.

Digestibility. In each case five grams of the meat were taken. The meat was cut into small pieces and immersed in 30 cc. of the artificial gastric juice in a test tube. The digestive fluid was prepared by dissolving 3.35 milligrams of scale pepsin in 100 cc. of 0.2 per cent. hydrochloric acid. The tubes containing the meat and digestive fluid were placed in an incubator and kept at a temperature of about 38° C. for 48 hours. The residue from the digestion was collected upon a weighed filter paper by filtration. The filter paper with its residue was placed in a desiccator over sulphuric acid and left there until all of the moisture had been absorbed or until a constant weight had been obtained. The dry residue and filter paper were again weighed and the original

*Preliminary Observations on Bob Veal. Report of the New York State Veterinary College, 1909-1910.

Bob Veal and the Public. American Veterinary Review, May, 1912.

Further observations on Bob Veal. Report of New York State Veterinary College, 1910-1911.
Bob Veal and the Conservation of the Meat Supply. Proceedings of the American Veterinary Medical Association, 1912.

weight of the filter paper was subtracted in order to obtain the exact weight of the dry residue. In this way the amount of the meat which had been dissolved or digested by the enzyme might be obtained. The following table shows the results. The figures represent the percentage of loss of weight or amount digested of the original 5 grams of meat.

AGE IN DAYS.	BOB VEAL.		MARKET VEAL.			BEEF.		
	Loin	Round	Age unknown	Loin	Round	Age unknown	Loin	Round
	%	%		%	%		%	%
2.....	89.08	83.84	.....	84.76	87.68	.....	85.34	85.40
3.....	86.28	85.62	.....	95.84	87.36	.....	85.94	87.90
4.....	90.60	85.24	.....	90.12	86.34	.....	84.18	87.40
5.....	90.72	87.94	.....	88.52	88.10	.....	78.28	81.00
5.....	87.18	84.22	.....	81.74	80.96	.....	79.20	80.92
7.....	88.70	87.18	.....	83.76	80.90	.....	82.74	87.20
9.....	83.46	85.84	.....	82.40	83.42	.....	77.08	80.80
11.....	81.98	81.52	.....	87.40	79.08	.....	85.60	81.86
13.....	86.42	85.36	.....	88.24	85.46	.....	85.36	82.38
15.....	79.74	80.74	.....	83.90	84.36	.....	81.42	80.24
16.....	80.86	83.34	.....	82.60	80.34	.....	77.20	80.60
17.....	81.86	89.58	.....	80.78	90.28	.....	89.98	89.91
18.....	88.74	86.68	.....	79.93	80.98	.....	77.62	78.72
19.....	86.18	80.40	.....	90.68	78.12	.....	82.68	81.80
20.....	69.24	86.54	.....	83.22	83.40	.....	85.10	80.98
21.....	89.54	86.36	.....	84.72	84.94	* (15)	82.51	83.52
22.....	87.42	85.90	.....	85.53	80.26	.....	.....	77.67
23.....	86.14	84.22	* (16)	.....	84.54	.....	.....	.....
25.....	84.70	87.68	.....	.....	83.14	* (17)	.....	82.25
26.....	84.38	81.50	* (18)	.....	.....	.....	.....	.....
27.....	86.20	81.52	.....	.....	.....	.....	.....	.....
28.....	81.28	84.36	.....	.....	.....	.....	.....	.....
Aver. 22 calves.	85.03	84.79	.....	.....	.....	.....	.....	.....

*Average number of samples.

Normal meat contains a certain percentage of water and in the breaking down of the tissue by the enzyme this water mingles with that of the solution. The residue that entered into the calculations, however, was in a perfectly dry condition. This was essential because with variable quantities of moisture in the residues less accurate results would be secured. For complete accuracy the meat should have been deprived of its water before digestion; but because meat is not eaten in a dry state, and the conditions governing the tests were the same throughout, the data may be accepted from a comparative standpoint.

The results show that, as regards the averages, the differences in the digestibility of the tissues of the bob veal and market veal are so slight as to be negligible; but such as they are they are

slightly in favor of the bob veal as a whole. The differences between the beef and veal is more noticeable, but the apparent greater digestibility of the veal may be due in part to the fact that as a rule there is a slightly smaller percentage of water present in the beef as well as a somewhat greater amount of connective tissue. As the greatest difference shown by the averages is but 3 per cent. under the conditions of the experiments, it would indicate no serious difficulties in the digestibility of any of the material.

Decomposability. General statements have been made to the effect that the tissues of bob veal decompose more readily than do those of mature veal or beef. Unfortunately this phase of the question was not thought of until toward the close of the investigation and only a few experiments were attempted. Introductory experiments were carried out by placing samples of the tissues of bob and market veal and beef separately in dry test tubes. Also similar samples were immersed in water in test tubes. All of the tubes were set aside at the ordinary room temperature to await decomposition. Each sample received a separate number so that the person carrying on the observations could not distinguish between the veal samples. The beef could be easily distinguished by its deeper color and the difference in texture. The process of decomposition was noted by the sense of smell and any physical change in the sample. Two days after the preparation of the tubes, the dry sample of beef gave the most pronounced odor, the next in order was that of the market veal and the least odor came from the bob veal (aged 7 days). The bob veal tube had a slight amount of water in it which might have gotten in accidentally or possibly filtered out of the tissue to a slight extent. In the wet tubes a slight odor of decomposition was apparent in the beef tube while the veal tubes were practically free from it. Four days after the preparation the dry tubes showed the least change in the bob veal, while the market veal and beef tubes showed about an equal amount of decomposition change as regards each other. In the wet tubes the most pronounced odor came from the beef tube, next the market veal and least from the bob veal.

After sixteen days, among the dry tubes, the greatest amount of putrefaction appeared to be in the market veal and next in the

beef and less in the bob veal. In the wet tubes there seemed to be about the same amount of decomposition in each of the three tubes.

After 47 days, among the dry tubes, the beef showed less volume and appeared as if it had undergone some liquefaction and later a semicoagulation. In the market veal the upper portion of the mass had dried out while the lower portion presented the appearance of an attempt at coagulation. In the bob veal, there was less change which was perhaps due to the accidental presence of a small amount of water. Among the wet tubes, the fluid about the bob veal had developed a yellow or straw color which was not present in the others. At this time all of the wet tubes were tested for the presence of indol with negative results.

In a second experiment carried on similarly to the one just described, there appeared, among the dry tubes, after two days some odor in the beef tube while the veal tubes were odorless. The wet tubes were all devoid of odor. After three days all of the dry tubes had odor but that of the beef tube was more pronounced. All the wet tubes had a little odor and some scum had formed in each. After twelve days, the beef, in the dry tubes, was discolored and more decomposed than the veal, but practically no difference could be distinguished as to the veal samples. After forty-three days, among the dry tubes, the beef sample was the most dried out while the veal samples were dried out above and of a semisolid consistence below. Among the wet tubes the (nine-day-old) bob veal sample responded to a test for indol, the others were negative.

While the sense of smell is of use relatively in making such determinations, if proper periods of rest be allowed between the "sniffs," there is, however, more opportunity for error than when chemical tests are employed.

In the later experiments Ebers' reagent was used. It consists of:

Hydrochloric acid	1 part	
Alcohol	3 parts	
Ether	1 part	.

A small glass tube or glass rod, after immersion in the reagent, is held over the suspected meat, or the meat may be held over a small quantity of the fluid. If decomposition has set in a cloud

forms. The principle of the test is that as decomposition develops ammonia is formed which being volatile combines with the hydrochloric acid to form clouds presumably of ammonium chloride.

The indol test was carried out by adding a few drops of concentrated sulphuric acid to the suspected fluid and then placing 1 cc. of a fresh solution of sodium nitrite upon the fluid. If indol is present a pink ring will form where the two fluids meet. This method of contact seems to give more sensitive results than when the fluids are mixed. All of the indol tests were performed with the contents of the wet tubes.

In all of the experiments the samples were identified by numbers and the observer did not know from what tissue they were taken until the completion of the work. The dry and wet tubes were used as before.

In this experiment (No. 3) all of the dry samples were found to be fly-blown three days after their preparation and in the beef sample maggots were present. All were smelling bad and gave a reaction with Ebers' reagent. In the wet tubes there was a slight odor in each but the beef sample was the only one to react with Ebers' fluid. After six days all of the wet tubes reacted with Ebers. After eleven days the beef and bob veal (aged 4 days) still reacted with Ebers while the market veal was negative. The bob veal also reacted to the indol test while the others were negative in this respect. After thirteen days the beef still gave a slight reaction with Ebers while both veals were negative. All were negative to indol. After fourteen days, traces of a reaction with Ebers were obtained in the beef and bob veal while the market veal was doubtful. All were negative to indol. After twenty-six days there was some indol in the beef sample, more in the bob veal and none in the market veal. After thirty-one days there was indol in all three samples but less in the market veal. After thirty-eight days there was a fairly good indol test with the bob veal, but faint in the beef and market veal.

Experiment No. 4. After three days all were negative to Ebers. After eight days all the dry tubes smelled bad. The bob veal sample presented the best appearance. The beef had many maggots and gave a marked reaction with Ebers. The market

veal was also positive but not so marked as the beef. The bob veal was negative in this respect. In the wet tubes the beef and market veal reacted with Ebers while the bob veal was negative. All were negative to indol. After ten days the bob veal was still negative to Ebers among the dry samples. The beef and market veal both gave a marked reaction and showed maggots. Indol negative. After thirteen days the dry bob veal sample showed a reaction with Ebers and a few maggots. The beef showed the most decomposition and had shrunk to about half its original size and had undergone some liquefaction. The market veal was not so badly decomposed as the beef but was in worse condition than the bob veal. Indol negative. After thirty-four days there was a suspicious trace of indol in the bob and market veal but none in the beef. After 78 days all were negative to indol.

Experiment No. 5. In this experiment two samples of bob veal were carried along with those of the beef and market veal. One bob calf was two days old, the other eleven days. After two days all were negative to Ebers. After four days all reacted except the two day bob. After seven days all reacted but the two day bob gave only a slight reaction. Indol negative. After nine days all reacted with Ebers but the two day bob less than the others. After eleven days all reacted — the market veal and beef being the most pronounced. After eighteen days the two day bob gave a reaction for indol, the eleven day bob gave a suspicious trace while the market veal and beef remained negative. After twenty-eight days there was no satisfactory test for indol in any. After seventy-two days all were negative to indol.

Experiment No. 6. Two bob calves, one aged three and the other five days old, were also used in this experiment along with the beef and market veal. The three day bob was killed three days before the five day calf. Observations were begun four days after the killing of the five day bob. Some allowance should therefore be made for the greater opportunity for decomposition in the three day calf. At the end of the four days the three day bob had some odor; it also gave a slight reaction with Ebers; the five day bob gave a suspicious reaction, the market veal was negative, while the beef gave a slight reaction, among the dry samples. After six days, among the dry samples, the beef gave a marked

reaction with Ebers; the market veal, a good reaction; the three day bob was negative, while the five day bob gave a good reaction. After thirteen days, all of the dry samples reacted with Ebers. Indol negative in all. After twenty-three days, among the wet samples, the three day bob gave a trace of indol, the others were negative. After sixty-seven days all were negative to indol.

In the following tables the + sign stands for the presence and the — sign for the absence of the substance:

No. 3. DAYS.	BOB VEAL (4 DAYS).		MARKET VEAL.		BEEF.	
	Ammonia.	Indol.	Ammonia.	Indol.	Ammonia.	Indol.
3 (dry).....	+	.....	+	.....	+	.....
3 (wet).....	+	.....	+	.....	+	.....
6 (wet).....	+	.....	+	.....	+	.....
11.....	+	+	—	—	+	—
13.....	—	—	—	—	+	—
14.....	Trace.	—	?	—	Trace.	—
26.....	.....	More.	.....	—	.....	+
31.....	.....	+	.....	Less.	.....	+
38.....	.....	+	.....	Faint.	.....	Faint.

No. 4. DAYS.	BOB VEAL (13 DAYS).		MARKET VEAL.		BEEF.	
	Ammonia.	Indol.	Ammonia.	Indol.	Ammonia.	Indol.
3.....	—		—		—	
8.....	—		+		Marked.	.....
8 (wet).....	—		+		+	
10.....	—		Marked.	.....	Marked.	.....
13.....	+					
34.....		Suspicious.	.....	Suspicious.	.....	—
78.....		—		—		—

No. 5. DAYS.	BOB VEAL (2 DAYS).		BOB VEAL (11 DAYS).		MARKET VEAL.		BEEF.	
	Ammonia.	Indol.	Ammonia.	Indol.	Ammonia.	Indol.	Ammonia.	Indol.
2.....	—	.....	—	.....	—	.....	—	.....
4.....	—	.....	+	.....	+	.....	+	.....
7.....	Slight.	.....	+	.....	+	.....	+	.....
9.....	Leaa.	.....	+	.....	+	.....	+	.....
11.....	+	.....	+	.....	Marked.	.....	Marked.	.....
18.....	.....	+	.....	Suspici.	.....	—	.....	—
28.....	.....	—	.....	—	.....	—	.....	—
72.....	.....	—	.....	—	.....	—	.....	—

No. 6. DAYS.	BOB VEAL (3 DAYS).		BOB VEAL (5 DAYS).		MARKET VEAL.		BEEF.	
	Ammonia.	Indol.	Ammonia.	Indol.	Ammonia.	Indol.	Ammonia.	Indol.
4.....	Slight.	.....	Suspicious.	.....	—	.....	Slight.	.....
6.....	—	.....	+	.....	+	.....	Marked.	.....
13.....	+	.....	+	.....	+	.....	+	.....
23.....	.....	Trace.	.....	—	.....	—	.....	—
67.....	.....	—	.....	—	.....	—	.....	—

A summary of the chemical tests shows that with the six specimens of bob veal and the four of market veal and beef that decomposition products according to the ammonia tests appeared first or at the same time or gave stronger reactions with the beef; the market veal was a close second in this respect, while the bob veal was slower in responding or gave less pronounced reactions. On the other hand the tests for indol appeared first or gave stronger reactions in the bob veal. Including the introductory experiments, only one of the six specimens of beef gave the reaction for indol; two of the six specimens of market veal reacted; while six of the eight specimens of bob veal gave a reaction for this substance.

It would appear from these experiments that decomposition must be pretty well advanced before indol appears and that Ebers' reagent is of more use in detecting the initial changes. Ammonia was found as early as three days in all three of the dry samples in one experiment. The longest period before its presence was detected was thirteen days in a sample of bob veal. The shortest period in which the presence of indol was detected was eleven days in a sample of bob veal, although it was apparently absent in two subsequent tests but reappeared later on. The latest date in which it first appeared in the bob veal was thirty-four days. The earliest date for its appearance in market veal was thirty-one days; while the earliest and only time it appeared in the beef was twenty-six days.

Freezing Point. The method of determining the freezing point has been described in previous papers. Data have now been obtained for the whole bob veal period of four weeks and this is now included with that previously published. For convenience and

comparison the data is arranged in weekly periods. For the first two weeks a number of duplicates and a few triplicates have been added; the added numbers making the averages somewhat more reliable.

BOB VEAL, FIRST WEEK.

DATE.	Number.	Age.	Loin.	Round.
			<i>Degrees.</i>	<i>Degrees.</i>
July 13, 1910.....	2	1 day.....	—0.923	—0.894
February 3, 1912.....	17	2 days.....	—0.933	—0.913
August 12, 1913.....	37	2 days.....	—0.923	—0.922
October 5, 1911.....	11	3 days.....	—1.011	—0.9535
August 18, 1913.....	40	3 days.....	—0.863	—0.8635
August 18, 1910.....	3	4 days.....	—0.965	—0.959
December 9, 1910.....	8	4 days.....	—0.972	—0.942
July 17, 1913.....	35	4 days.....	—0.877	—0.959
October 20, 1911.....	12	5 days.....	—0.970	—0.976
July 6, 1912.....	18	5 days.....	—0.915	—0.988
August 16, 1913.....	39	5 days.....	—0.9695	—0.951
September 10, 1910.....	4	6 days.....	—0.924	—0.9855
December 15, 1910.....	9	6 days.....	—0.9345	—0.962
July 27, 1911.....	10	7 days.....	—0.950	—0.964
March 21, 1913.....	33	7 days.....	—1.018	—1.011
Average of 15 calves.....	.....	.....	—0.9437	—0.9495

BOB VEAL, SECOND WEEK.

DATE.	Number.	Age.	Loin.	Round.
			<i>Degrees.</i>	<i>Degrees.</i>
October 7, 1910.....	5	8 days.....	—0.795	—0.826
November 21, 1911.....	14	9 days.....	—0.951	—1.0125
March 25, 1913.....	34	9 days.....	—0.952	—0.9525
November 23, 1911.....	15	10 days.....	—0.935	—0.918
November 19, 1910.....	7	11 days.....	—0.849	—0.987
August 13, 1913.....	38	11 days.....	—0.9645	—0.9485
December 4, 1911.....	16	12 days.....	—0.9255	—0.9625
November 9, 1911.....	13	13 days.....	—0.971	—0.987
August 6, 1913.....	36	13 days.....	—0.985	—1.049
November 9, 1910.....	6	14 days.....	—1.0885	—1.117
Average of 10 calves.....	.....	.....	—0.9416	—0.976

BOB VEAL, THIRD WEEK.

DATE.	Number.	Age.	Loin.	Round.
			<i>Degrees.</i>	<i>Degrees.</i>
January 28, 1913.....	30	15 days.....	—0.964	—1.028
February 12, 1913.....	32	16 days.....	—0.9875	—1.028
February 13, 1913.....	31	17 days.....	—1.199	—1.153
August 31, 1912.....	22	18 days.....	—1.011	—1.038
December 3, 1912.....	27	19 days.....	—1.013	—1.065
August 29, 1912.....	21	20 days.....	—0.991	—1.054
January 3, 1913.....	29	21 days.....	—1.0285	—1.0795
Average of 7 calves.....	.....	.....	—1.0277	—1.0636

BOB VEAL, FOURTH WEEK.

DATE.	Number.	Age.	Loin.	Round.
			<i>Degrees.</i>	<i>Degrees.</i>
August 13, 1912.....	20	22 days....	—0.983	—1.0395
December 24, 1912.....	28	23 days....	—0.983	—1.033
October 5, 1912.....	26	24 days....	—0.979	—1.033
July 27, 1912.....	19	25 days....	—1.079	—1.025
September 10, 1912.....	23	26 days....	—1.013	—1.065
October 1, 1912.....	25	27 days....	—0.992	—1.031
September 12, 1912.....	24	28 days....	—0.9655	—1.052
Average of 7 calves.....	.....	.....	—0.9992	—1.0397

In comparing the averages, it is evident that the freezing point of the first and second week samples are nearer to each other than is either of these weeks with the third or fourth week. This is still further emphasized by comparing the averages of the first and second weeks with those of the third and fourth weeks as shown in the following table:

	Loin.	Round.
Average of 25 samples, first and second weeks	—0.9427°	—0.9601°
Average of 14 samples, third and fourth weeks	—1.0134°	—1.0517°

In the first week the results show that the freezing point was not depressed as low as 1° except in three instances out of 30 samples; in the second week it was not depressed as low as 1° except in four instance out of 20 samples. In the third week it was depressed lower than 1° in all but three instances out of 14 samples; in the fourth week it was also depressed lower than 1° excepting in five instances out of 14 samples. In these two weeks the samples from the round fell below 1° in every instance—the exceptions occurring in the loin. From the standpoint of the freezing point there would seem to be a natural differentiation of the tissues so far as the amount of solids is concerned at the end of the second week. The total average for all the samples of the four weeks is —0.9681° for the loin and 0.993° for the round. That the total average shows a depression of less than 1° is probably due to the fact that there were nearly twice as many samples

in the first two week period as occur in the third and fourth week period together.

The freezing point of samples of market veal was also taken for comparison.

MARKET VEAL.

Date.	Loin.	Date.	Round.
July 25, '10...	—1.158°	July 19, '10...	—1.026°
Aug. 5, '10...	—1.085°	?	—1.240°
Aug. 16, '10...	—1.192°	Aug. 2, '10...	—1.111°
Aug. 29, '10...	—1.234°	Aug. 12, '10...	—0.923°
		Aug. 26, '10...	—1.035°
July 5, '11...	—1.0405°	July 3, '11...	—1.0645°
July 7, '11...	—1.045°	July 6, '11...	—1.1315°
July 10, '11...	—1.0125°	July 8, '11...	—1.0055°
July 15, '11...	—1.087°	July 12, '11...	—1.123°
July 19, '11...	—1.159°	July 13, '11...	—1.091°
July 31, '11...	—0.980°	July 17, '11...	—1.130°
Aug. 3, '11...	—1.101°	July 28, '11...	—0.9045°
Aug. 7, '11...	—1.0015°	Aug. 1, '11...	—1.082°
Aug. 9, '11...	—1.0515°	Aug. 4, '11...	—1.1165°
Aug. 13, '11...	—1.0205°	Aug. 8, '11...	—1.1045°
Aug. 16, '11...	—1.0655°	Aug. 10, '11...	—1.1095°
Aug. 18, '11...	—0.991°	Aug. 15, '11...	—1.055°
Aug. 21, '11...	—0.9485°	Aug. 17, '11...	—1.079°
Aug. 23, '11...	—1.0975°	Aug. 19, '11...	—1.1155°
Aug. 29, '11...	—1.019°	Aug. 22, '11...	—1.124°
Sept. 1, '11...	—0.961°	Aug. 28, '11...	—1.092°
		Aug. 31, '11...	—1.090°
July 17, '13...	—1.094°	July 17, '13...	—1.1155°
Aug. 7, '13...	—1.0275°	Aug. 7, '13...	—1.120°
Average (22) —1.0623°		Average (24) —1.0828°	

A survey of the table shows that the freezing point was depressed more than 1° C, except in four instances for the loin and two for the round.

The freezing point of beef tissue was also determined as follows:

BEEF.

Date.	Loin.	Date.	Round.
July 29, '10...	—1.069°	July 19, '10...	—1.051°
Aug. 9, '10...	—1.142°	Aug. 8, '10...	—1.044°
Aug. 24, '10...	—1.175°	Aug. 22, '10...	—1.018°
?	—1.149°	?	—1.311°
July 3, '11...	—0.970°	July 2, '11...	—1.052°
July 8, '11...	—1.054°	July 5, '11...	—1.0785°
July 12, '11...	—0.963°	July 6, '11...	—1.0725°
July 15, '11...	—0.917°	July 7, '11...	—1.013°
July 19, '11...	—1.1455°	July 10, '11...	—1.037°
July 31, '11...	—0.977°	July 13, '11...	—1.108°
Aug. 4, '11...	—1.175°	July 17, '11...	—1.041°
		July 28, '11...	—1.0305°
Aug. 7, '11...	—1.0105°	Aug. 1, '11...	—1.049°
Aug. 9, '11...	—1.047°	Aug. 4, '11...	—1.057°
Aug. 13, '11...	—1.107°	Aug. 8, '11...	—1.109°
Aug. 16, '11...	—0.9905°	Aug. 10, '11...	—1.0545°
Aug. 18, '11...	—1.0665°	Aug. 15, '11...	—1.099°
Aug. 21, '11...	—1.040°	Aug. 17, '11...	—1.079°
Aug. 23, '11...	—1.179°	Aug. 19, '11...	—1.060°
Aug. 29, '11...	—1.0675°	Aug. 22, '11...	—1.175°
Sept. 1, '11...	—0.994°	Aug. 28, '11...	—1.095°
July 17, '13...	—1.087°	Aug. 31, '11...	—1.177°
Aug. 7, '13...	—1.072°	July 17, '13...	—1.154°
		Aug. 7, '13...	—1.065°
Average (22) —1.0635°		Average (24) —1.0846°	

In the loin there were six instances in which the freezing point was not depressed as far as 1° C, but in all the other samples, including the round, it was depressed more than 1° C.

The averages for the first and second halves of the bob veal period and the market veal and beef are shown in the following table:

	Loin.	Round.
Bob veal 1-14 days.....	—0.9427°	—0.9601°
Bob veal 15-28 days.....	—1.0134°	—1.0517°
Market veal	—1.0623°	—1.0828°
Beef	—1.0635°	—1.0846°
The difference between the first and second halves of the bob veal is....	—0.0707°	—0.0916°
Between the second half of the bob veal period and market veal.....	—0.0489°	—0.0311°
Between the market veal and beef....	—0.0012°	—0.0018°

While these averages show that there is but a slight difference between beef and market veal as to the freezing point, and that the difference between the market veal and the second half of the bob veal period is less than that between the latter and the first half of the period, there are individual exceptions to the classification as given.

The number of individual exceptions which do not correspond with the averages are as follows:

	Num- ber of samples.	Loin.	Num- ber of samples.	Round.
Bob veal 1-7 days freezing point depressed <i>more</i> than 1° C...	15	2	15	1
Bob veal 8-14 days freezing point depressed <i>more</i> than 1° C...	10	1	10	3
Bob veal 15-21 days freezing point depressed <i>less</i> than 1° C...	7	3	7	0
Bob veal 22-28 days freezing point depressed <i>less</i> than 1° C...	7	5	7	0
Market veal freezing point depressed <i>less</i> than 1° C.....	22	4	24	2
Beef freezing point depressed <i>less</i> than 1° C.....	22	6	24	0
Total.....	83	21	87	6

This table shows that the exceptions are about three and a half times more numerous in the loin than in the round samples, or on the percentage basis for the total number there were about 25 per cent, of exceptions among the loin samples and about 7 per cent. among the round samples. The line of cleavage or greatest differentiation lies in the middle of the bob veal period. The percentage of exceptions in the first half of this period is 12 per cent. for the loin and 17 per cent. for the round samples. Grouping the second half of the bob veal period with the market veal and beef there is shown to be about 31 per cent. of exceptions

among the loin samples and only 0.3 per cent. among the round. It is obvious that if the freezing point method were used for detecting bob veal, samples from the loin would be much less reliable than those from the round. Further, the method would be of practically no use in detecting bob veal more than two weeks of age, because the results from calves ranging in age from fifteen to twenty-eight days are more closely in accord with those of the market veal and beef.

More accurate results might be expected if the conditions regarding the market veal and beef were as controllable as were those of the bob veal. In the case of the latter the freezing point determinations were made within a day after the death of the animal except in two or three instances. In the case of the market veal and beef the time of death was entirely unknown as was also the period of cold storage. The moisture content of the tissue in any of the samples might be expected to vary according to the external conditions. In a dry atmosphere of proper temperature it is reasonable to assume that some of the moisture in the meat might diffuse into the surrounding medium and that the freezing point of the tissue juice under these conditions might be still further depressed. On the other hand if there were a superabundance of moisture in the atmosphere with proper conditions as to temperature, it would be expected that the meat might absorb a portion of the moisture and under such circumstances the freezing point would not be so fully depressed. Other conditions as rigor mortis or the action of enzymes or ferments in the tissue itself might influence the results.

Bearing on this question, experiments were tried on twenty-one bob calves to determine if continued exposure at ordinary temperatures affected the freezing point of the tissue. The second determination of the freezing point was made two or three days after the first. The results showed that in eighteen of the twenty-one calves the freezing point was depressed lower than in the first determination. In the three exceptions there was only one calf in which the second freezing point was not depressed so far as the first in both loin and round. In the other two exceptions the freezing point of the loin rose while that of the round was depressed or vice versa. A third determination of the freezing

point was made two or three days after the second in the case of six of the bob calves. In four out of six specimens of the loin the freezing point rose usually higher than the second but not as high as the first freezing point. In the one exception both the second and third were higher than the first. In the case of the round of these six calves there was a continuous depression of the freezing point in the three determinations, except in one instance where the third rose nearly as high as the first. Allowing for occasional instances of mechanical error which might creep into the work, the general inference seems to be justifiable that the tissue, especially the round, loses a certain amount of moisture on exposure to the air. The loin is much more variable and less satisfactory as a standard for comparison.

Specific Gravity. The specific gravity was obtained from the same tissue juice that was used in the freezing experiments. The pycnometer was utilized for this purpose on account of its convenience where only a small amount of the fluid is available. The fluid was introduced into the bulb at the end of the instrument and the whole immersed in a jar of distilled water. The reading was then taken from the scale of the instrument. The following tables show the readings as taken for each week of the calves' age for the bob veal as well as the readings for the market veal and beef.

BOB VEAL, FIRST WEEK.

DATE.	Number.	Age.	Loin.	Round.
July 13, 1910.....	2	1 day....	1.023	1.033
February 3, 1912.....	17	2 days....	1.021	1.018
August 12, 1913.....	37	2 days....	1.032	1.032
October 5, 1911.....	11	3 days....	1.026	1.025
August 18, 1913.....	40	3 days....	1.030	1.028
August 18, 1910.....	3	4 days....	1.027	1.020
December 9, 1910.....	8	4 days....	1.023	1.026
July 17, 1913.....	35	4 days....	1.020	1.023
October 30, 1911.....	12	5 days....	1.027	1.027
July 6, 1912.....	18	5 days....	1.025	1.024
August 16, 1913.....	39	5 days....	1.033	1.032
September 10, 1910.....	4	6 days....	1.025	1.025
December 15, 1910.....	9	6 days....	1.027	1.030
July 27, 1911.....	10	7 days....	1.027	1.032
March 21, 1913.....	33	7 days....	1.035	1.033
Average (15).....	.....	.....	1.0267	1.0272

BOB VEAL, SECOND WEEK.

DATE.	Number.	Age.	Loin.	Round.
October 7, 1910.....	5	8 days..	1.018	1.020
November 21, 1911.....	14	9 days..	1.030	1.032
March 25, 1913.....	34	9 days..	1.025	1.025
November 23, 1911.....	15	10 days..	1.028	1.025
November 10, 1910.....	7	11 days..	1.020	1.030
August 13, 1913.....	38	11 days..	.....	1.034
December 4, 1911.....	16	12 days..	1.031	1.033
November 9, 1911.....	13	13 days..	1.032	1.032
August 6, 1913.....	36	13 days..	1.035	1.037
November 10, 1910.....	6	14 days..	1.028	1.030
Average (9).....	.....	.....	1.0274	(10) 1.0298

BOB VEAL, THIRD WEEK.

	Number.	Age.	Loin.	Round.
January 28, 1913.....	30	15 days..	1.035	1.038
February 12, 1913.....	32	16 days..	1.030	1.035
February 12, 1913.....	31	17 days..	1.033	1.038
August 31, 1912.....	22	18 days..	1.024	1.032
December 3, 1912.....	27	19 days..	1.034	1.038
August 29, 1912.....	21	20 days..	1.024	1.027
January 3, 1913.....	29	21 days..	1.032	1.033
Average (7).....	.....	.....	1.0302	1.0344

BOB VEAL, FOURTH WEEK.

DATE.	Number.	Age.	Loin.	Round.
August 13, 1912.....	20	22 days..	1.028	1.030
December 24, 1912.....	28	23 days..	1.033	1.036
October 5, 1912.....	26	24 days..	1.032	1.035
July 27, 1912.....	19	25 days..	1.032	1.030
September 10, 1912.....	23	26 days..	1.042	1.046
October 1, 1912.....	25	27 days..	1.032	1.035
September 12, 1912.....	24	28 days..	1.033	1.035
Average (7).....	.....	.....	1.0331	1.0352

MARKET VEAL.

Date.	Loin.	Date.	Round.
July 25, '10...	—1.029	June 6, '10...	—1.030
Aug. 15, '10...	—1.035	Aug. 2, '10...	—1.040
Aug. 16, '10...	—1.035	Aug. 12, '10...	—1.030
July 5, '11...	—1.032	Aug. 26, '10...	—1.035
July 7, '11...	—1.035	July 3, '11...	—1.033
July 10, '11...	—1.032	July 6, '11...	—1.035

Date.	Loin.	Date.	Round.
July 15, '11...	—1.034	July 8, '11...	—1.032
July 19, '11...	—1.038	July 12, '11...	—1.035
July 31, '11...	—1.032	July 13, '11...	—1.031
Aug. 3, '11...	—1.034	July 17, '11...	—1.037
Aug. 7, '11...	—1.027	July 28, '11...	—1.032
Aug. 9, '11...	—1.027	Aug. 1, '11...	—1.035
Aug. 13, '11...	—1.032	Aug. 4, '11...	—1.045
Aug. 16, '11...	—1.028	Aug. 8, '11...	—1.034
Aug. 18, '11...	—1.028	Aug. 10, '11...	—1.037
Aug. 29, '11...	—1.032	Aug. 15, '11...	—1.032
Sept. 1, '11...	—1.025	Aug. 17, '11...	—1.033
July 17, '13...	—1.035	Aug. 28, '11...	—1.027
Aug. 7, '13...	—1.032	Aug. 31, '11...	—1.034
		July 17, '13...	—1.037
		Aug. 7, '13...	—1.033
Average (19)	—1.0317	Average (21)	—1.0341

BEEF.

Date.	Loin.	Date.	Round.
July 29, '10...	—1.030	July 19, '10...	—1.034
Aug. 9, '10...	—1.035	Aug. 8, '10...	—1.028
Aug. 24, '10...	—1.035	Aug. 22, '10...	—1.030
Dec. 23, '10...	—1.035	Dec. 23, '10...	—1.035
July 3, '11...	—1.035	July 5, '11...	—1.033
July 8, '11...	—1.030	July 6, '11...	—1.032
July 12, '12...	—1.027	July 7, '11...	—1.032
July 15, '11...	—1.032	July 10, '11...	—1.032
July 19, '11...	—1.035	July 13, '11...	—1.034
July 31, '11...	—1.032	July 17, '11...	—1.027
Aug. 4, '11...	—1.033	July 28, '11...	—1.034
Aug. 7, '11...	—1.030	Aug. 1, '11...	—1.032
Aug. 9, '11...	—1.032	Aug. 4, '11...	—1.040
Aug. 13, '11...	—1.033	Aug. 8, '11...	—1.037
Aug. 16, '11...	—1.023	Aug. 10, '11...	—1.035
Aug. 18, '11...	—1.030	Aug. 15, '15...	—1.038
Aug. 29, '11...	—1.033	Aug. 17, '11...	—1.033

Date.	Loin.	Date.	Round.
Sep. 1, '11...	—1.027	Aug. 19, '11...	—1.028
July 17, '13...	—1.033	Aug. 28, '11...	—1.027
Aug. 7, '13...	—1.035	Aug. 31, '11...	—1.035
		July 17, '13...	—1.034
		Aug. 7, '13...	—1.033
Average (20)	—1.0317	Average (22)	—1.0328

As in the case of the freezing point, some experiments were tried in getting a second specific gravity of the tissue juice after the meat had been exposed to the ordinary temperature of the room for two or three days. This was tried in only six or seven specimens during the first half of the bob veal period. In this period the second set of averages showed that the specific gravity was somewhat heavier than for the first set. In the second half of the bob veal period about as many samples were tested as for the first set. For the third week of the calves' age the average of the specific gravity was somewhat heavier than for the first set. For the fourth week the average for the second set was somewhat lighter than that of the first set in the case of the loin, while the average of the two sets was the same for the round. The general results would indicate, from the specific gravity, that some of the moisture of the meat was diffused into the surrounding atmosphere.

Corresponding with the freezing point experiments the line of cleavage or differentiation lies in the middle of the bob veal period. The following table shows a comparison of the averages:

	Loin.	Round.
Bob veal 1-14 days	1.027	1.0282
Bob veal 15-28 days	1.0317	1.0348
Market veal.....	1.0317	1.0341
Beef ..	1.0317	1.0328

Percentage of water. As the foundation of the investigation was based upon the amount of water in the three types of tissue and in order to make the results more complete and to check up the freezing point and specific gravity methods, the amount of water was determined directly by desiccating a given quantity of

meat until a constant weight was attained. Ten grams of the meat were placed in a watch glass in a desiccator over strong sulphuric acid. The samples were weighed at intervals until a constant weight was reached. The difference between the weight of the dry residue and the original weight of the meat represented the amount of water lost. This was calculated on a percentage basis as shown in the following tables:

Bob Veal — First Week.

No.	Age.	Loin.	Round.
2	1 day	78.49%	78.17%
17	2 days	71.81%	81.31%
11	3 days	77.83%	77.96%
40	3 days	81.11%	81.22%
3	4 days	77.55%	78.75%
35	4 days	77.95%	78.21%
12	5 days	79.40%	78.92%
18	5 days	80.48%	78.97%
39	5 days	77.33%	75.87%
4	6 days	81.19%	80.89%
10	7 days	.....	78.41%
33	7 days	79.08%	78.80%
Average (11)		78.38%	(12) 78.95%

Bob Veal — Second Week.

No.	Age.	Loin.	Round.
5	8 days	79.37%	77.86%
14	9 days	74.81%	76.60%
34	9 days	79.38%	79.66%
15	10 days	76.63%	77.16%
7	11 days	80.19%	80.32%
38	11 days	77.21%	77.32%
16	12 days	73.81%	75.98%
13	13 days	76.36%	78.43%
6	14 days	77.77%	79.21%
Average (9)		77.28%	78.06%

Bob Veal — Third Week.

No.	Age.	Loin.	Round.
30	15 days	75.83%	76.75%
32	16 days	.....	70.78%
31	17 days	75.70%	75.81%
22	18 days	75.77%	75.24%
27	19 days	76.05%	76.18%
21	20 days	74.52%	74.98%
29	21 days	77.64%	75.13%
Average (6)		75.91%	(7) 74.98%

Bob Veal — Fourth Week.

No.	Age.	Loin.	Round.
20	22 days	74.28%	75.02%
28	23 days	74.45%	74.63%
19	25 days	77.03%	76.67%
23	26 days	75.64%	74.71%
25	27 days	.....	74.36%
24	28 days	66.18%	76.61%
Average (5)		73.51%	(6) 75.33%

Market Veal.

Date.	Loin.	Date.	Round.
July 27, 1910.....	63.03%	July 20, 1910.....	75.64%
Aug. 5, 1910.....	70.94%	Aug. 2, 1910.....	71.04%
Aug. 17, 1910.....	73.48%	Aug. 12, 1910.....	78.43%
Aug. 30, 1910.....	74.21%	Aug. 26, 1910.....	73.56%
July 7, 1911.....	77.50%	July 8, 1911.....	75.97%
July 10, 1911.....	79.10%	July 13, 1911.....	78.32%
July 19, 1911.....	75.26%	July 17, 1911.....	75.00%
Aug. 3, 1911.....	83.19%	July 28, 1911.....	72.39%
Aug. 7, 1911.....	77.05%	Aug. 1, 1911.....	75.86%
Aug. 9, 1911.....	76.80%	Aug. 4, 1911.....	76.63%
Aug. 13, 1911.....	77.20%	Aug. 10, 1911.....	74.77%

Date.	Loin.	Date.	Round.
Aug. 16, 1911.....	74.75%	Aug. 15, 1911.....	75.29%
Aug. 18, 1911.....	75.98%	Aug. 17, 1911.....	75.49%
Aug. 21, 1911.....	78.31%	Aug. 19, 1911.....	77.32%
Aug. 23, 1911.....	75.27%	Aug. 22, 1911.....	75.95%
Aug. 29, 1911.....	77.93%	Aug. 31, 1911.....	75.26%
Sept. 1, 1911.....	77.90%	July 18, 1913.....	74.41%
July 18, 1913.....	76.38%	Aug. 8, 1913.....	76.78%
Aug. 18, 1913.....	80.87%		
Average (19).....		Average (18).....	75.45%

Beef.

Date.	Loin.	Date.	Round.
July 30, 1910.....	70.69%	July 20, 1910.....	74.96%
Aug. 9, 1910.....	69.30%	Aug. 8, 1910.....	70.99%
Aug. 25, 1910...	76.20%	Aug. 23, 1910.....	77.06%
July 8, 1911.....	74.18%	July 7, 1911.....	59.40%
July 12, 1911.....	77.78%	July 10, 1911.....	73.47%
July 15, 1911.....	75.81%	July 13, 1911.....	77.33%
July 31, 1911.....	72.85%	July 28, 1911.....	55.08%
Aug. 4, 1911.....	77.14%	Aug. 1, 1911.....	76.82%
Aug. 7, 1911.....	69.28%	Aug. 4, 1911.....	74.50%
Aug. 9, 1911.....	72.27%	Aug. 10, 1911.....	72.54%
Aug. 13, 1911.....	72.76%	Aug. 15, 1911.....	70.43%
Aug. 16, 1911.....	72.82%	Aug. 17, 1911.....	73.49%
Aug. 21, 1911.....	74.63%	Aug. 19, 1911.....	74.44%
Aug. 23, 1911.....	75.07%	Aug. 22, 1911.....	74.47%
Aug. 29, 1911.....	74.19%	Aug. 31, 1911.....	71.42%
July 18, 1913.....	73.17%	July 18, 1913.....	84.22%
Aug. 8, 1913.....	74.41%	Aug. 8, 1913.....	72.78%
Average (17).....		Average (17).....	72.55%

A glance at the averages of the different tables shows that the amount of water present has a tendency to diminish as the tissues grow older, although there are individual exceptions in each

table. As with the freezing point and specific gravity the line of differentiation appears to fall in the middle of the bob veal period. The average for the loin of the market veal is however an exception in that it agrees more closely with that of the first bob veal period.

	Loin Per cent.	Round Per cent.
Bob veal, 1-14 days.....	77.88	78.57
Bob veal, 15-28 days.....	74.82	75.14
Market veal	76.06	75.45
Beef	73.68	72.55

The following table summarizes the results of all three methods:

	FREEZING POINT.		SPECIFIC GRAVITY.		PERCENTAGE OF WATER.	
	Loin.	Round.	Loin.	Round.	Loin.	Round.
	<i>Degrees.</i>	<i>Degrees.</i>			<i>Per cent.</i>	<i>Per cent.</i>
Bob Veal, 1-14 days....	-0.9427	-0.9601	1.027	1.0282	77.88	78.57
Bob veal, 15-28 days....	-1.0134	-1.0517	1.0317	1.0348	74.82	75.14
Market veal.....	-1.0623	-1.0828	1.0317	1.0341	76.06	75.45
Beef.....	-1.0635	-1.0846	1.0317	1.0328	73.68	72.55

As a result of the tests, the interesting fact appears that, up to five days of age, there appears to be a larger percentage of water present in the round than in the loin of the bob calf, but in the majority of cases from that age up the percentage of water in the round is less than that of the loin. A possible explanation is that at the time of birth the percentage of water is more or less uniform, but in those parts which are dependent from the body the water or lymph, through gravity or otherwise, may accumulate to some extent. Those muscles which come into more active use gradually develop a greater proportion of solids, and so as the calf begins to use its limbs for supporting the weight of the body and for locomotion a somewhat greater amount of solids develop and there is relatively a slightly smaller percentage of water present. In general it would, therefore, appear that the muscles of the round serve a more active purpose than do those of the loin and the latter have relatively

a slightly lower proportion of solids. The tenderloin is generally considered the choicest portion because of its juicy and tender character.

As to the individual variations from the averages, found in all of the tables: it is a well known fact that some calves are born with more vigor and apparently in a more mature condition than others. Some calves a few days after birth appear to be as hearty and vigorous as others a week or more older. Calves born prematurely a few days before term would naturally be expected to show a less favorable degree of development than others born a few days after term. The latter although younger might be expected to show a greater degree of vigor than the former and a correspondingly greater degree of development of the tissues.

Dietary Experiments. The number participating in this portion of the investigation has increased to a total of seventy-five during the period the work has been in progress. This includes sixteen families ranging in number from two to seven members. There was also a club of four students which was supplied a number of times and another club of eighteen students which received only one supply because the demand of such a large number at one time would limit the amount to be distributed among the families. Four of the families partook of each of the carcasses used; the others received their supply intermittently. Six of the families were of the university faculty while others were of the laboring class. In some of the families were children ranging in age from two years up; in one family was an individual seventy-five years of age and in some of the other families were individuals between sixty and seventy years, all of whom partook of the bob veal. All apparently enjoyed the meat and no one refused a second supply when another carcass became available. Each person receiving a portion of the carcass was informed as to the nature of the meat. The veal was treated similarly to meat purchased from the butcher and eaten with the other articles that serve to make up a meal. In some cases it was cooked with pork or other fat in order to make up for the deficiency of fat which naturally exists in the veal. The material was palatable and nutritious and a few reported that they had never eaten meat that was more delicious or tender than some

of the specimens of bob veal. With one exception, there was no report from any of the seventy-five individuals as to any physiological disturbances following the ingestion of the veal. The health apparently remained normal in every particular. The exception was a laboring man, who stated that he came to his evening dinner with a hearty appetite and a tendency to overeat. He stated that with him macaroni generally caused diarrhea and that the veal was served with it and in his own mind he was in doubt whether the diarrhea was due to overeating or the veal or the macaroni or to the combination. In spite of the diarrhea he was very ready to receive more veal and did receive several helpings without a recurrence of the trouble. Idiosyncrasy is a factor which should be considered in any dietetic experiment. As is well known, there are some who cannot eat any form of veal and in some it is claimed that mature veal will cause diarrhea. It would therefore be expected that those individuals who are susceptible to untoward effects from mature veal would react similarly to bob veal.

Economics. The statistics for a number of years show that the supply of cattle has been decreasing while the human population has been increasing at a fairly rapid rate, until the situation has now become acute. The result has been a considerable increase in cost to the consumer and it is fair to assume that many of the laboring class are unable to supply themselves with this staple article of food to the same extent as formerly.

Statistics also show that more veal has been consumed of late years with the result that fewer animals are allowed to reach the beef age, which means a loss of some hundreds of pounds of meat per carcass because the calf was not allowed to live until it was one or two years of age. This state of affairs indicates that the taste of the public for veal has increased and that the growing demand has made serious inroads into the supply of beef and for this the public itself is chiefly responsible. Another important factor, in many sections at least, is that the farmer, with present prices, finds it more profitable to dispose of the calf while in the veal stage than to maintain it for a year or two at considerable cost for its feed, which obviously diminishes his profit. Many farmers also claim that they find it more profitable to sell

their grain at the present high prices than to convert it into beef which, oftentimes, they state they are obliged to sell at a loss, and so have abandoned beef raising more or less permanently. Efforts are being made by the use of silage and economical methods of nutrition to diminish the cost of production. A dual purpose cow has been recommended or the breeding of a dairy cow with a beef producing bull, with the idea that the calf will inherit some of the beef qualities of its sire. The passage of a law to prohibit the slaughter of calves has also been suggested, the purpose being to increase the amount of meat which would otherwise be lost if the calf was killed for veal. Protests against such an arrangement might be expected from a public which has developed such a taste for veal that the supply can scarcely equal the demand, as well as from farmers who are inclined to feel that they should have the right to dispose of their stock as they please.

The disappearance of the open range feeding in the west by the increasing number of small farms has likewise had a very serious effect upon the production of beef. This condition, with the high prices, would seemingly encourage more breeding of stock among the farmers generally. It is not likely that all of the farmers are insensible to the situation, but their attitude for the present and the future will be determined largely by the question of profit and loss. The statistics in the following tables and in the plates at the end of the article show that, except for milk cows, there have been much greater fluctuations in the farm values than in the number of the beef cattle. From 1907 to 1913 inclusive there has been a continued decrease in the number of beef cattle, while for the same period the farm values have sometimes decreased as well as increased, indicating an unstable market. The price to the consumer has been steadily high, but the producers have faced the risk of loss as well as that of profit and, until a fairly stable market is reached and an economical method of rearing their stock is devised, it is unlikely that they will continue the business extensively. The following tables from the U. S. Department of Agriculture give the statistics as to the number and value of cattle for the past nine years for New York State and the United States:

NEW YORK STATE.

Date.	No. of milch cows.	Farm value.
January 1, 1906.....	1,755,972	\$60,581,034
January 1, 1907.....	1,826,211	65,743,596
January 1, 1908.....	1,789,000	59,932,000
January 1, 1909.....	1,789,000	61,273,000
January 1, 1910.....	1,771,000	69,954,000
January 1, 1911.....	1,510,000	73,235,000
January 1, 1912.....	1,495,000	64,734,000
January 1, 1913.....	1,465,000	73,250,000
January 1, 1914.....	1,465,000	83,505,000

	No. of other cattle.	
January 1, 1906.....	954,277	\$15,764,647
January 1, 1907.....	944,734	17,307,526
January 1, 1908.....	907,000	15,419,000
January 1, 1909.....	898,000	14,817,000
January 1, 1910.....	889,000	16,180,000
January 1, 1911.....	922,000	20,468,000
January 1, 1912.....	894,000	17,701,000
January 1, 1913.....	876,000	19,272,000
January 1, 1914.....	876,000	23,827,000

UNITED STATES.

	No. of milch cows.	
January 1, 1906.....	19,793,866	\$582,788,592
January 1, 1907.....	20,968,265	645,496,980
January 1, 1908.....	21,194,000	650,057,000
January 1, 1909.....	21,720,000	702,945,000
January 1, 1910.....	21,801,000	780,308,000
January 1, 1911.....	20,823,000	832,209,000
January 1, 1912.....	20,699,000	815,414,000
January 1, 1913.....	20,497,000	922,783,000
January 1, 1914.....	20,737,000	1,118,487,000

	No. of other cattle.	
January 1, 1906.....	47,067,656	\$746,171,709
January 1, 1907.....	51,565,731	881,557,398
January 1, 1908.....	50,073,000	845,938,000
January 1, 1909.....	49,379,000	863,754,000

	No. of other cattle.	Farm value.
January 1, 1910.....	47,279,000	\$917,453,000
January 1, 1911.....	39,679,000	815,184,000
January 1, 1912.....	37,260,000	790,064,000
January 1, 1913.....	36,030,000	949,645,000
January 1, 1914.....	35,855,000	1,116,333,000

The decrease in the cattle population in the face of a relatively rapidly increasing human population is sufficient cause for the most serious consideration of the question. Whether cattle, for food purposes, can be imported from other countries to a sufficient extent is problematical in the minds of many. That home production should be encouraged, all will admit; but the issue depends, apparently, upon the market and an economical system of rearing the stock.

The acuteness of the situation and the demand for veal make it very probable indeed that much bob veal is substituted in the market for the mature veal. According to a newspaper article one of the inland cities of New York State has consumed tons of bob veal in this way. The material was secured by buyers, who scoured the surrounding country districts for it. The buyers were reported to have purchased the living calves from the farmers, and slaughtered them at a convenient place and dressed and cut up the carcasses for market use. In the dressed form or when cut up it is practically impossible for a meat inspector to detect bob veal with any degree of certainty. Even if the newspaper article may have been exaggerated in its statements, the fact remains that carcasses of bob veal are occasionally detected and this demonstrates that attempts are made to put them in the market and would tend to confirm the belief that many of them do get through without detection.

The law in New York State prohibits the sale of veal less than four weeks of age for food purposes. Assuming that all of the farmers of the State are honest and law-abiding in this respect, then when calves are born into their herds which they do not care to rear, either because of the labor involved or because it is more economical to sell the milk as such or in the form of butter or cheese, or if the calf is of the wrong sex for milk production, the option left to the farmer is to destroy the calf, get what he can

for the hide and bury the carcass or give it as food to the swine or poultry. As an illustration of the waste that may occur in this way, of meat, which according to our experiments, is wholesome and nutritious, let us assume, conservatively, that only one calf on each of the farms of the State is disposed of in this way. According to the last census, there are 215,597 farms in New York State, 93.4% of which have domesticated animals upon them or 201,367 farms upon which it may be expected that calves may be born. The estimated average dressed weight of a number of bob calves used in our experiments was about fifty pounds. If only one bob calf was destroyed and thrown away each year on each of these farms it means a loss or waste of 10,068,350 pounds of wholesome meat. At the moderate price of ten cents per pound, this would mean a loss of \$1,006,835 annually for New York State alone. For the nation the waste and loss would be proportionately greater. Since the law prohibits the sale of bob veal for food, it is natural that the farmer should consider it unwholesome and unfit for consumption. Although the law prevents his marketing the bob calf, it does not prevent him nor his family from using it in their home. If farmers, generally, understood that bob veal is nutritious and wholesome and if safeguarded by the ordinary precautions used in keeping any form of meat sanitary, much of this tremendous waste might be reduced, in spite of the closed market, by consuming the flesh at their own tables. In some foreign localities calves a week or two old, or in some districts only a few days old, are used for food legally. This has been permitted for years and it is difficult to assume that such a practice would be sanctioned by law under an efficient system of meat inspection if the bob veal produced harmful effects upon those who consumed it. In this country the laws regulating bob veal are chaotic. The federal law for interstate commerce permits the use of calves over three weeks of age. Pennsylvania has a similar law. Other States require from four to six weeks of age and some apparently have no laws upon the subject. In Pennsylvania the calf is entirely fit and wholesome for food after it is three weeks of age, but if it is brought across an imaginary line into New York State it is wholly unfit and unwholesome for eating purposes until it is a week older. According to the

law of New York, the Pennsylvanians, although supported by the federal law, are eating bob veal if the calf is not four weeks of age. Similarly in Arkansas and Missouri, New Yorkers are eating bob veal if the calf has not attained the age of six weeks. Such a lack of uniformity in the laws is obviously not advantageous. Under the circumstances it would appear desirable that more effort should be devoted to bringing about a more uniform age limit. The federal law with its age limit of three weeks has been in effect about seven years. There is, apparently, no scientific reason why this three weeks age limit should not be taken as a basis of uniformity among those states which have laws upon the subject and much complication and confusion avoided. On the basis of our own experiments there is, in fact, no reason why the age limit might not be reduced to two weeks; for the direct experiments upon the tissue itself show that the meat of calves from two to four weeks of age is in its texture and quality more closely allied to the mature veal than to that of earlier age. At two weeks of age, the normal calf should have the umbilical cord, the most dependable clue for detecting bob veal, about healed up, and if it has received all of the nourishment it could use and with proper sanitary surroundings, it should be in good condition for food purposes.

The question of legalizing the sale of bob veal as such, with the age stated if desired, is also worthy of attention. Meat of this character ought to be marketed at a lower price than that of older veal and in this way made available for those who are unable to purchase the more expensive cuts. Even at the outset a considerable demand for it might be expected from the growing ranks of foreigners who live in this country and who were used to eating it in their native land and knew what they were getting.

The advocacy of such measures at the present time, when the sentiment of many is to restrict or prohibit the use of veal in order to increase the amount of the beef supply, may appear rash or even foolhardy; but the spirit of the investigation has been to seek the truth and to demonstrate in as practical a manner as possible whether or not the tissue of bob veal is unwholesome and unfit for food and if it produces injurious effects in those

who consume it. So much popular prejudice exists; so many statements have been made as to its harmfulness and so little has been done in the way of actual demonstration, that there appeared to be a real need for an investigation of this character.

My acknowledgments are due C. E. Hayden, upon whose skill and accuracy I have depended for the most of the mechanical data used in this investigation.

CONCLUSIONS.

The result of the digestion experiments with artificial gastric juice showed that, on the average, the digestibility of the bob veal and market veal was about the same and that both were digested to a slightly greater extent than beef.

Decomposition of the tissue, as shown by the presence of ammonia, occurred first in almost every instance in the beef and last in the bob veal. Indol, another decomposition product, was of late occurrence in all of the tissues, but appeared first and more frequently in the bob veal and last or rarely in the beef.

The freezing point, specific gravity and desiccation methods showed, on the average, a slightly greater percentage of water present in the tissues of the bob veal. All of these methods agreed in showing a line of differentiation in the middle of the four week bob veal period, and, as far as the amount of water present was concerned, that calves of three and four weeks of age were more closely allied with the mature calves than with those of the earlier age.

That the tissues of bob veal should be rejected for food purposes because of the slightly greater percentage of water present is inconsistent with the practice of eating oysters and certain fish in which the percentage of water is still greater, nor is the antipathy to the young tissue of bob veal consistent with the practice of eating squabs, which, although a luxury, are born in a helpless and relatively immature condition as compared with the calf which from the time of birth is active enough to help itself in various ways.

The dietetic experiments, including a total of seventy-five persons participating at one time or another in the investigation, showed no harmful physiologic effects from the bob veal when con-

sumed as food and served in the ordinary manner. The fact that it was served to individuals ranging from two to seventy years of age without apparent injurious effects, indicates the wide range and diverse physical conditions subjected to the test. If the tender age of childhood and the failing tissues of old age remain unharmed then we may reasonably assume that the average vigorous adult may consume bob veal with impunity. In the one exception referred to in the text, the evidence is not clear that the bob veal alone was the cause of the diarrhea. That other or contributory causes were concerned is probable from the fact that the trouble did not recur on other occasions.

The age limit of three weeks as provided for by the federal government is high enough and should serve as a standard for uniformity in those states and municipalities which have laws upon the subject. The reduction of the age limit to two weeks may safely be recommended in view of the tests that have been made.

In the absence of direct evidence of any harmful effect of the bob veal upon the human organism, there would seem to be no scientific reason why its sale as such may not be legalized. Its continued use as a legal food in certain foreign districts confirms the view of its harmlessness. A demand already exists among foreigners and with its lower cost its use may be expected to extend among those who cannot afford to purchase meat very frequently.

In view of the evidence submitted and in spite of the closed markets, it would appear that much waste of a useful food might be avoided if farmers understood that there is evidence to show that healthy bob veal, when kept in as sanitary condition as other meat, causes no harm and when it is desired to kill a calf, at an early age, for economic reasons, its flesh may be consumed at their own tables.

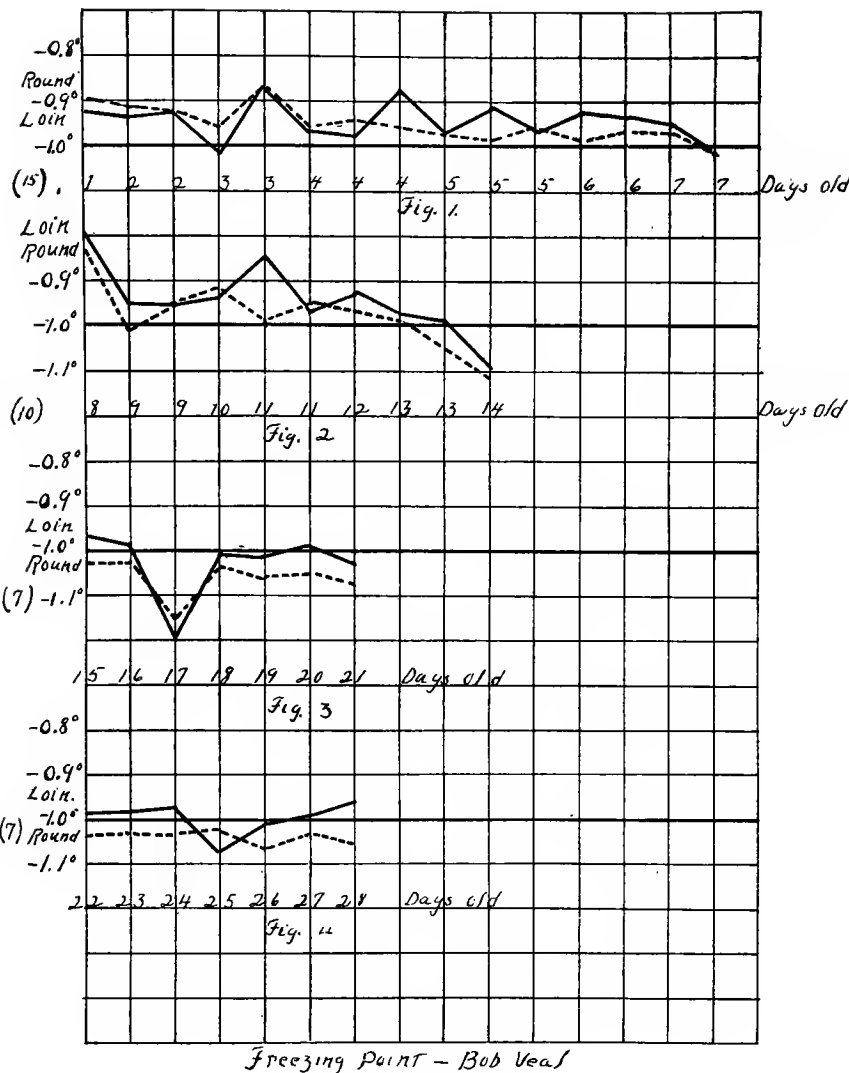


PLATE I.

The freezing point of Bob veal tissue. In each of the four curves, the heavy horizontal line represents -1° C. or 1° below the freezing point of distilled water. This is taken as the base line or standard of comparison as to how far the freezing points were depressed. Fig. 1 shows the freezing points of bob veal up to 1 week of age; Fig. 2, up to 2 weeks of age; Fig. 3, up to 3 weeks of age; Fig. 4, up to 4 weeks of age. Note that in Figs. 1 and 2 the freezing points are nearly all above the base line, while in Figs. 3 and 4 they are nearly all below, especially the round.

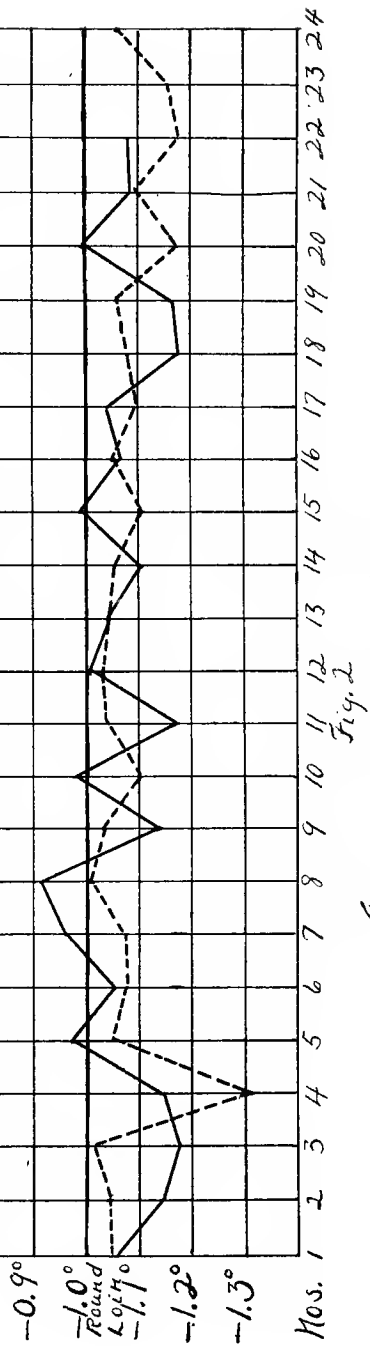
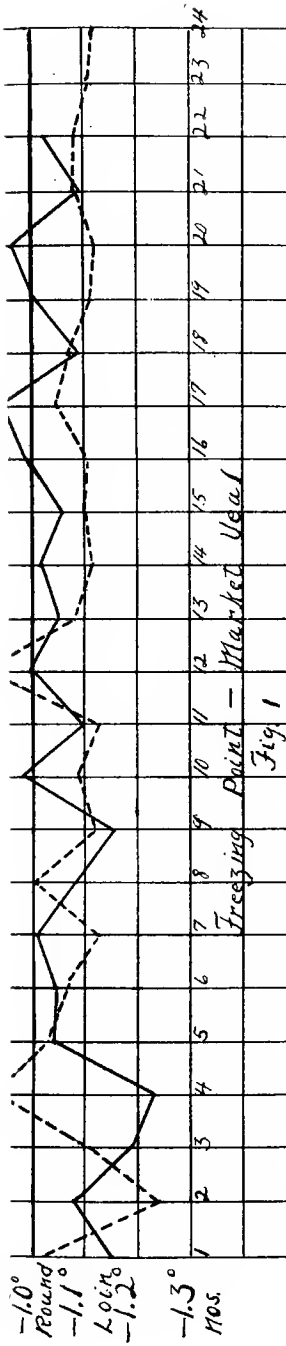


PLATE II.

Fig. 1. The freezing point curve for market veal.
 Fig. 2. The freezing point curve for beef.
 Note that the freezing points are mostly below the base line of -1° .

Specific Gravity - Bob Veal - 1 Week

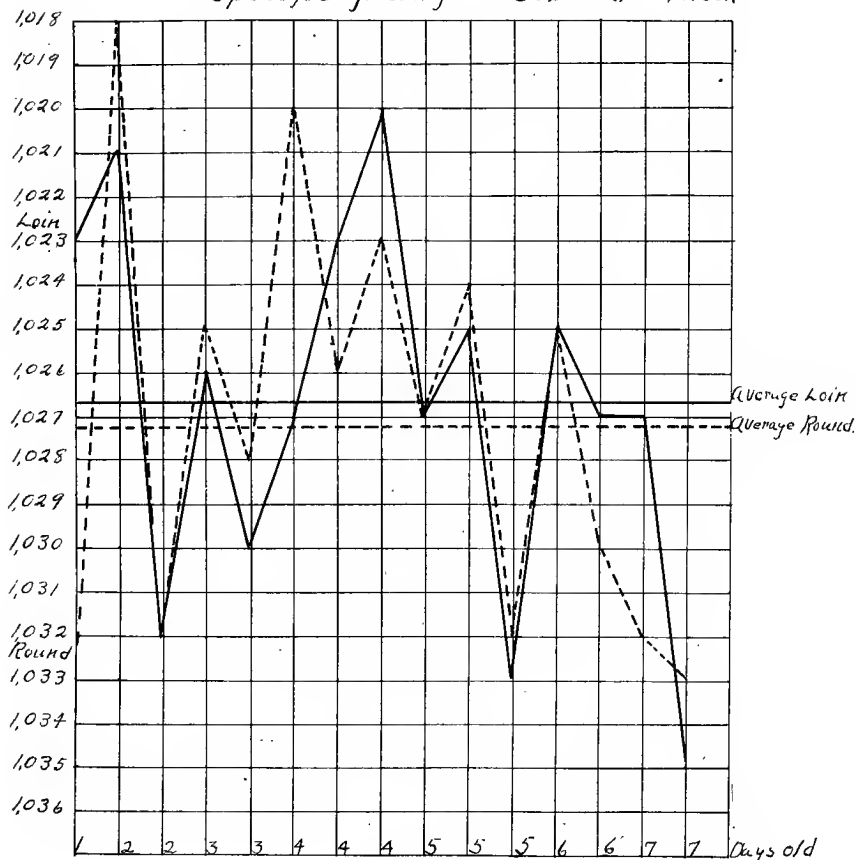
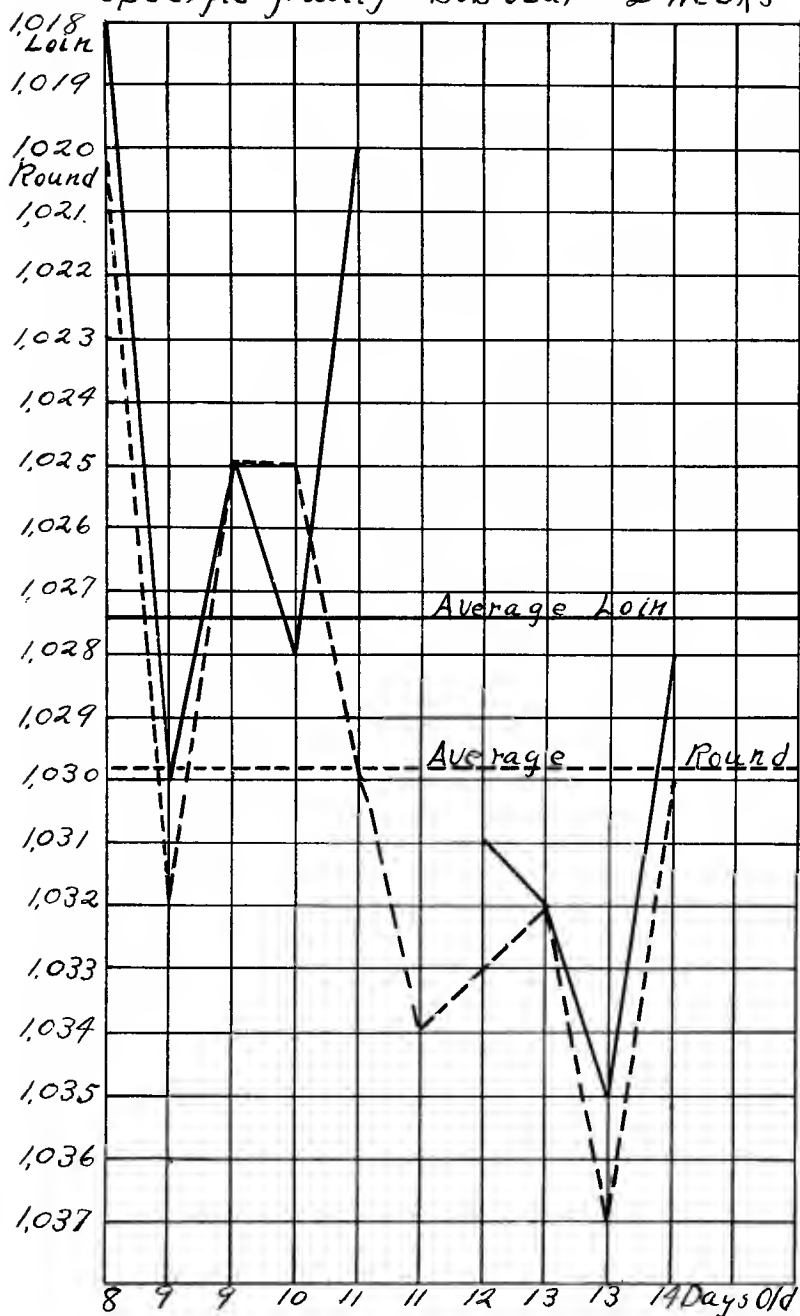


PLATE III.

The specific gravity curve of bob veal up to one week of age. The heavy continuous horizontal line represents the average specific gravity for the loin; the interrupted line for the round.

Specific Gravity - Bob Veal - 2 Weeks



IV.

The specific gravity curve for bob veal from one week up to two weeks of age.

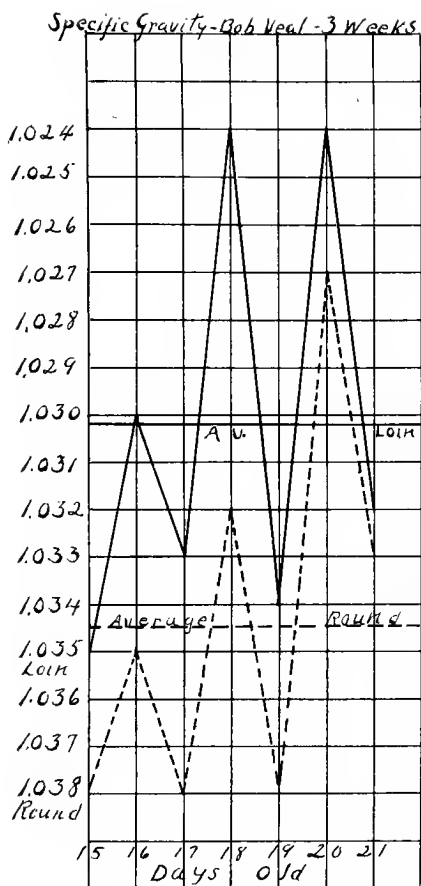


FIG. 1.

PLATE V.

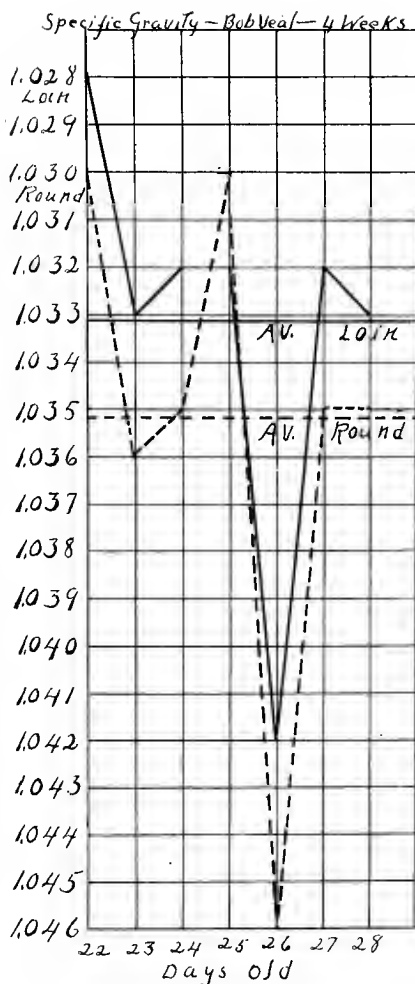
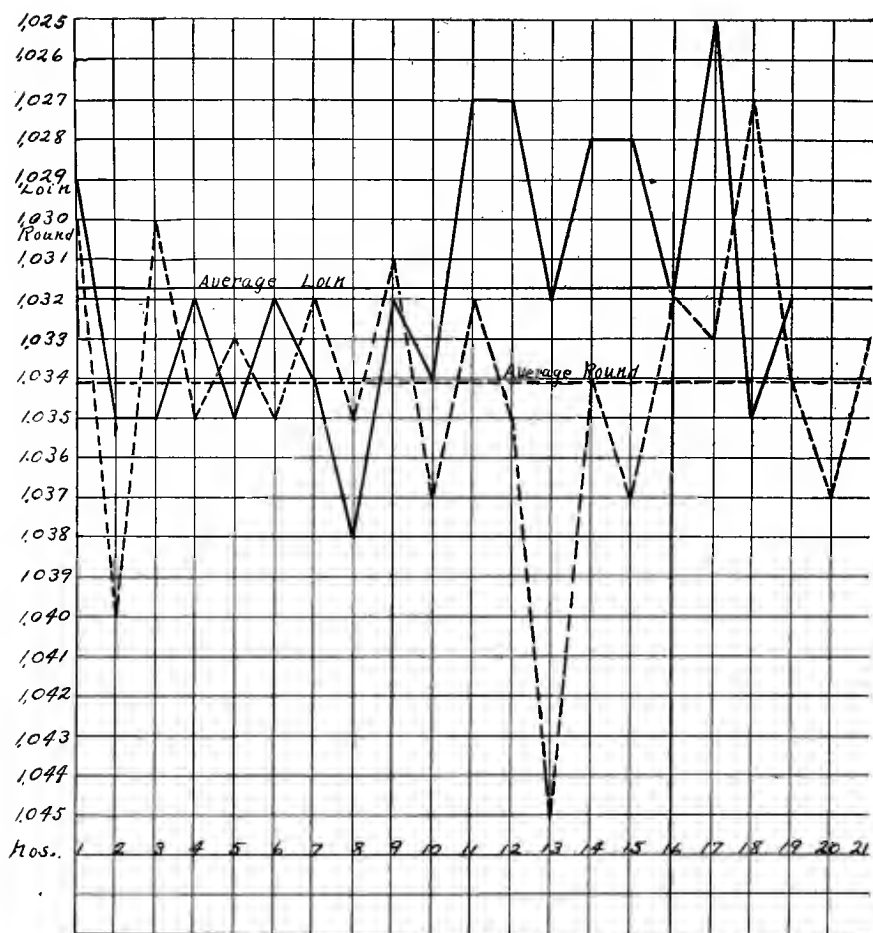


FIG. 2.

FIG. 1. The specific gravity curve of bob veal from two up to three weeks of age.
 FIG. 2. The specific gravity curve of bob veal from three up to four weeks of age.

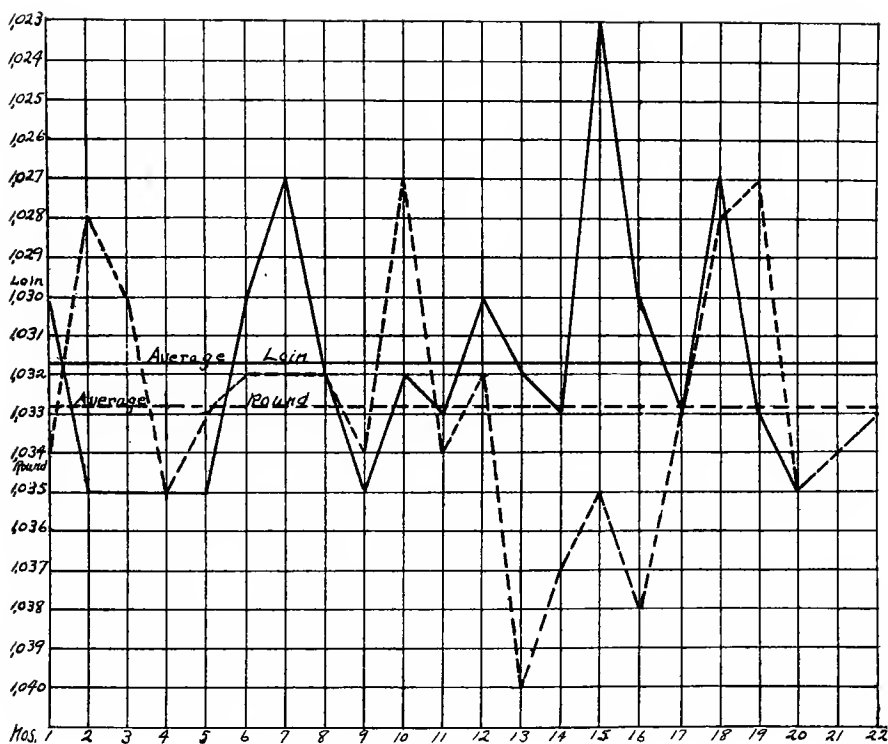


Specific Gravity - Market Veal.

PLATE VI.

The specific gravity curve of the market veal. The average specific gravity for the loin and round is shown in the horizontal continuous and interrupted lines.





Specific Gravity - Beef

PLATE VII.

The specific gravity curve of the beef. The average specific gravity for the loin and round is shown in the horizontal continuous and interrupted lines.

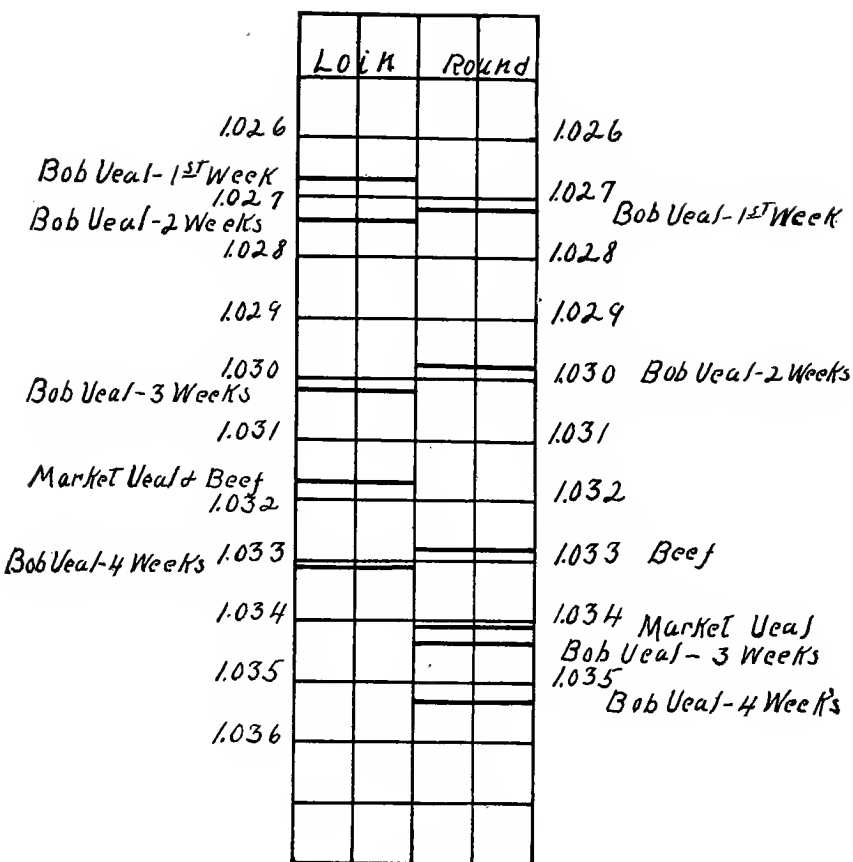
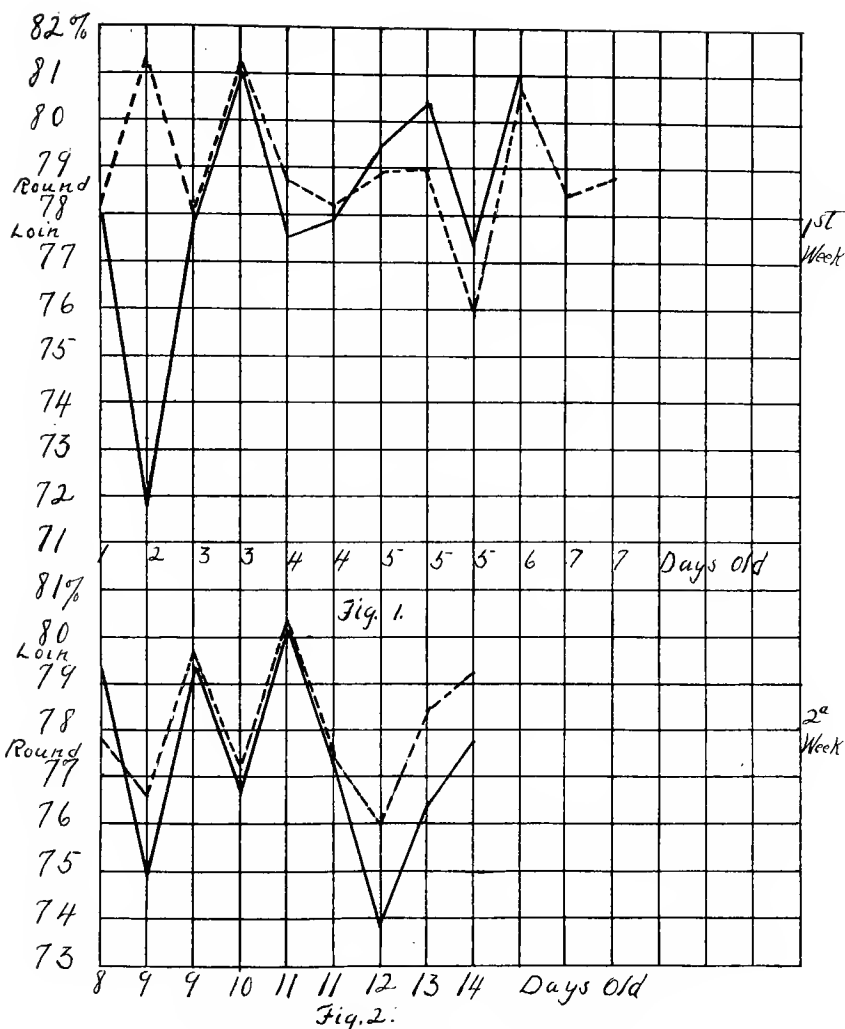


PLATE VIIa.

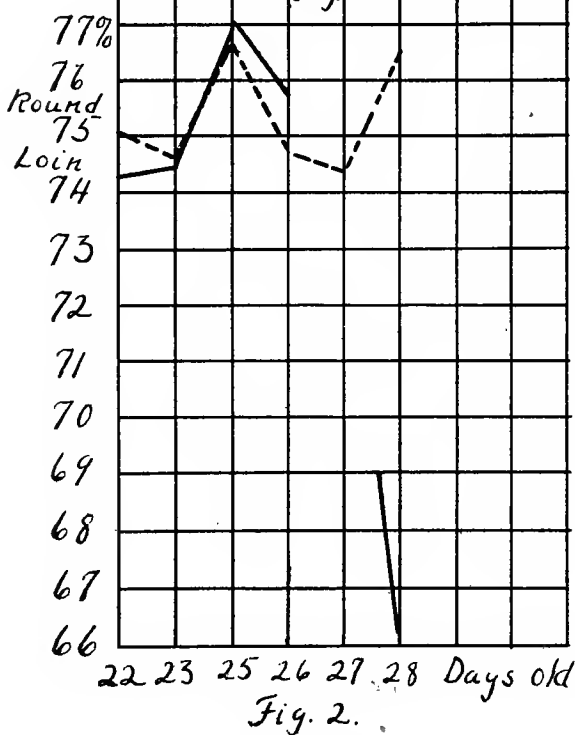
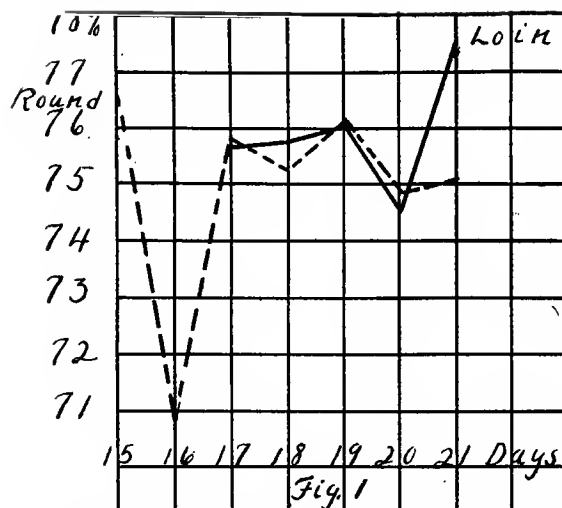
This figure shows the averages of the specific gravity for the four weeks of the bob veal, market veal and beef as read from the scale.



Percentage of Water - Bob Veal - 1-14 Days

PLATE VIII.

The percentage of water in bob veal. In the upper figure (1) the percentage curve is shown in calves from 1 to 7 days of age. In Fig. 2, the percentage is shown in calves from 8 to 14 days of age.



Percentage of Water-Bob Veal
15-28 Days

PLATE IX.

FIG. 1. Shows the curve for the percentage of water in calves from 15 to 21 days of age.

FIG. 2. A similar curve for calves from 22 to 28 days of age. For accidental reasons the percentage of water was not obtained from the 24-day-old calf and three samples of the loin, which explains the break in the loin curve of the two figures.

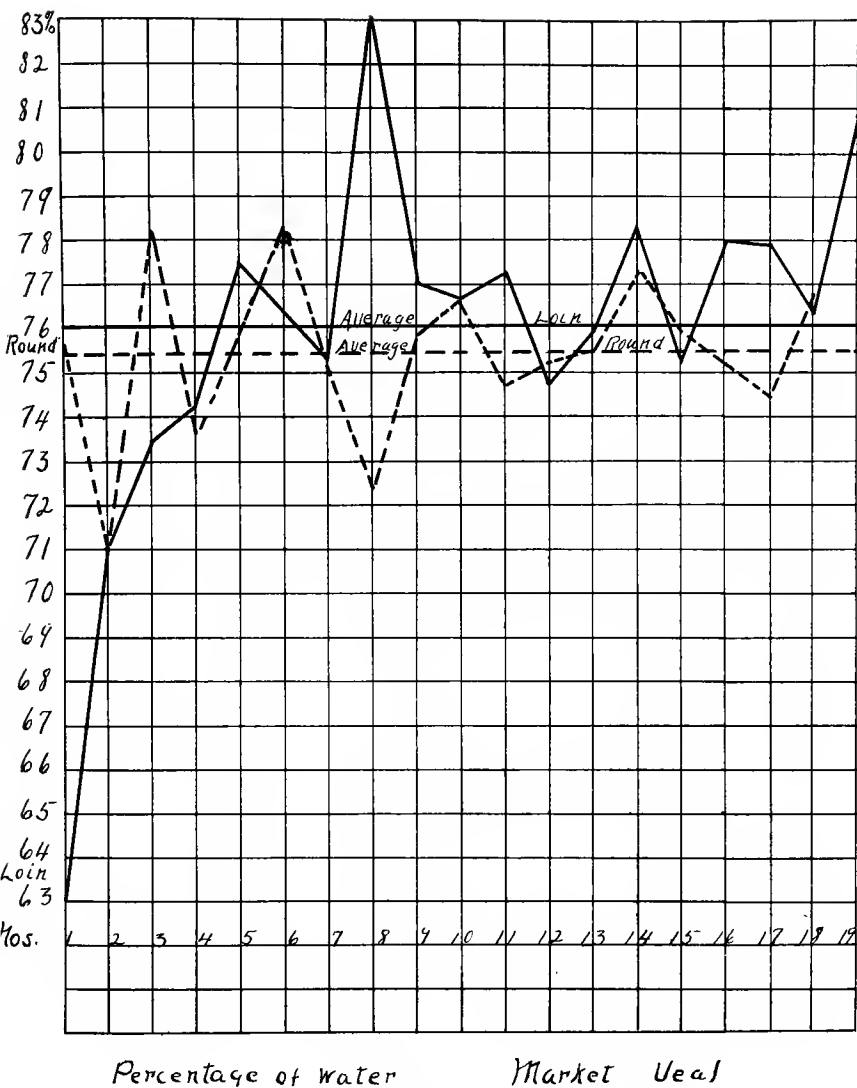


PLATE X.

The percentage of water in market veal. The two heavy horizontal lines represent the average percentage for the loin and round.

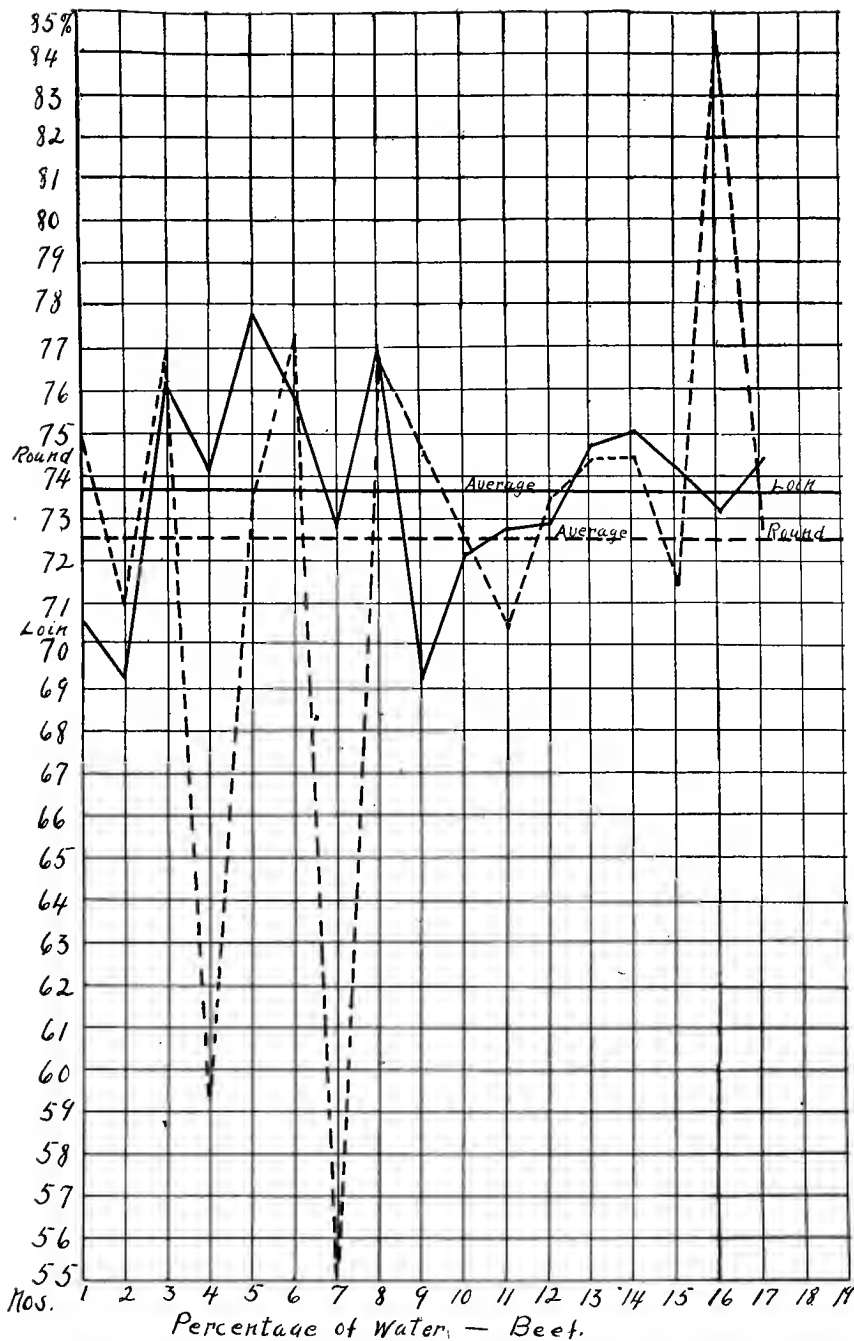
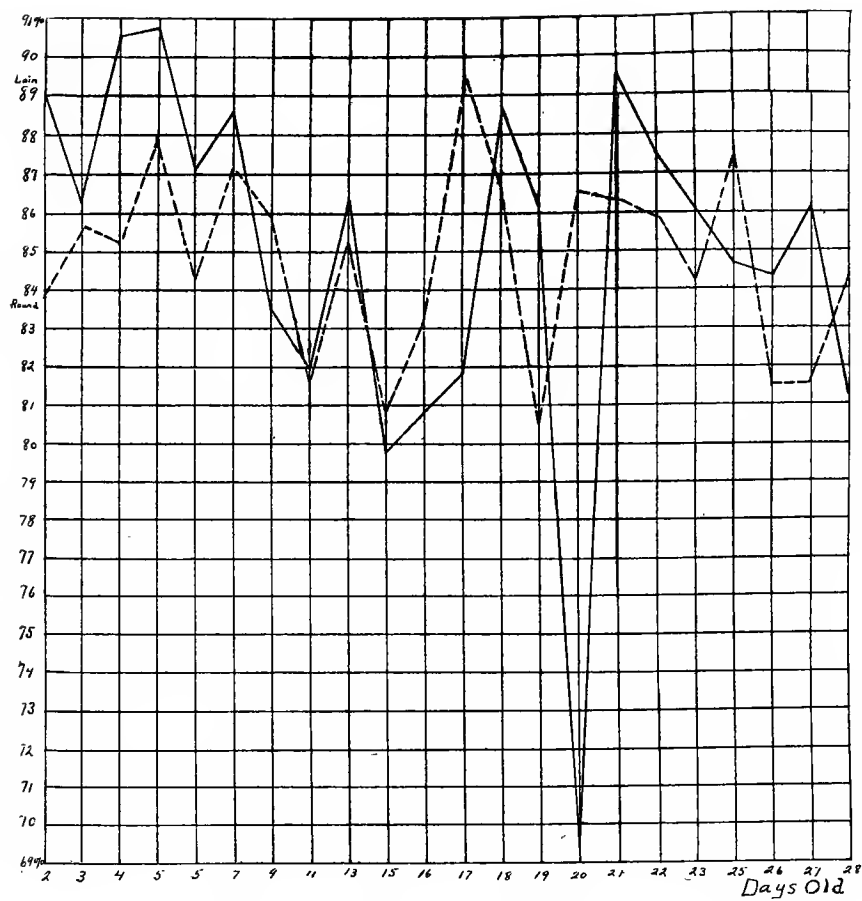


PLATE XI.

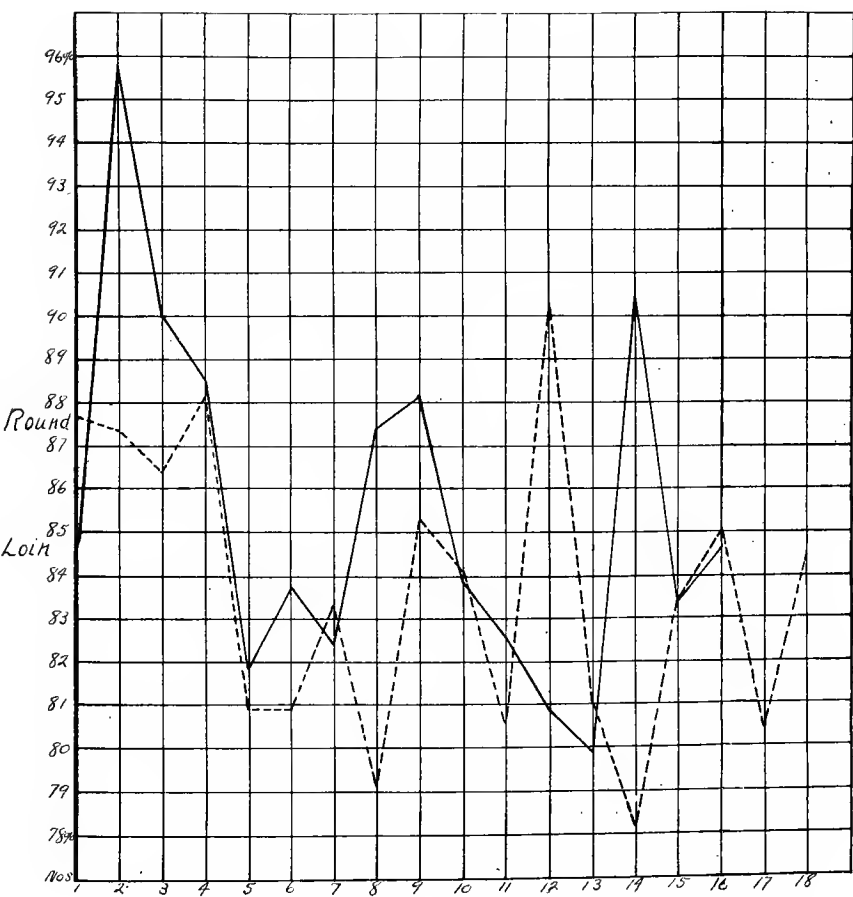
The percentage of water in beef. The two heavy horizontal lines represent the average percentage for the loin and round.



Percentage Digested — Bob Veal

PLATE XII.

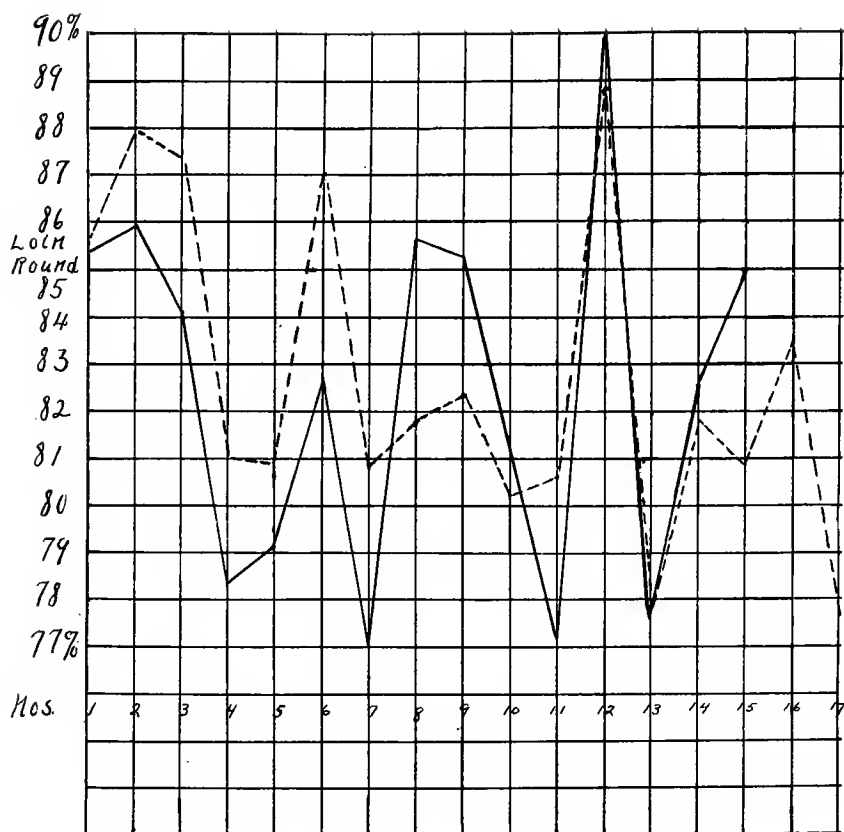
A curve showing the percentage of tissue digested in bob veal.



Percentage Digested—Market Veal

PLATE XIII.

A curve showing the percentage of the tissue digested in the market veal.



Percentage Digested — Beef.

PLATE XIV.

A curve showing the percentage of the tissue digested in the beef.

Each C.M. = 20,000 Cattle *Milch Cows-New York State* Each C.M. = 1,000,000

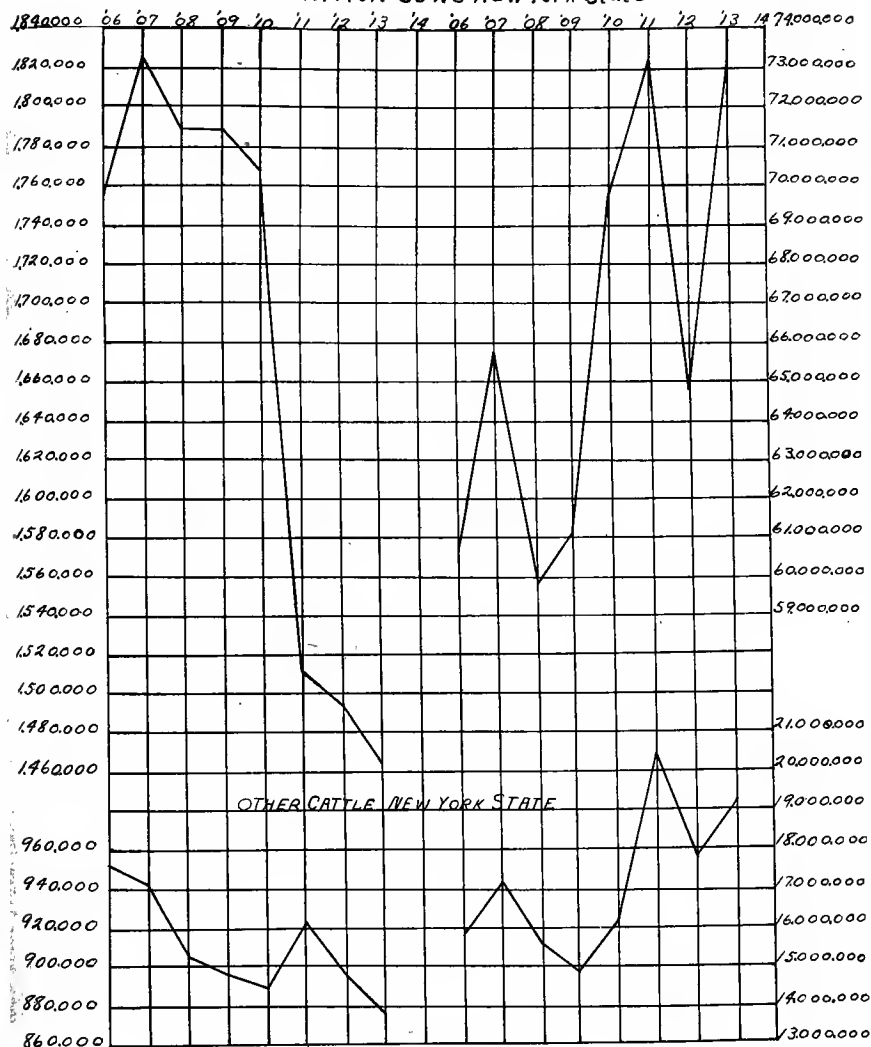


PLATE XV.

Diagram of the number (left) of milk cows (above) and other cattle (below) with the farm value (right) in the State of New York from January 1, 1906, to January 1, 1913. (Data from the U. S. Department of Agriculture.)

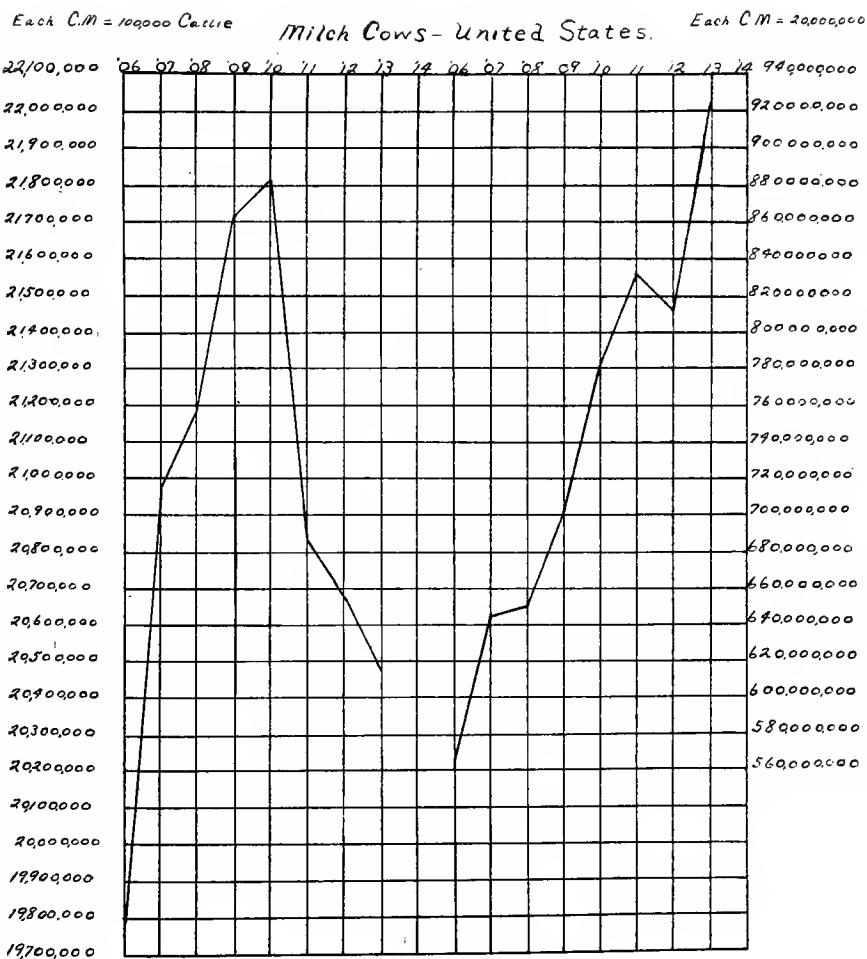


PLATE XVI.

Diagram showing the number (left) and farm value (right) of milk cows in the United States from January 1, 1906, to January 1, 1913.
(Data from the U. S. Dept. of Agriculture.)

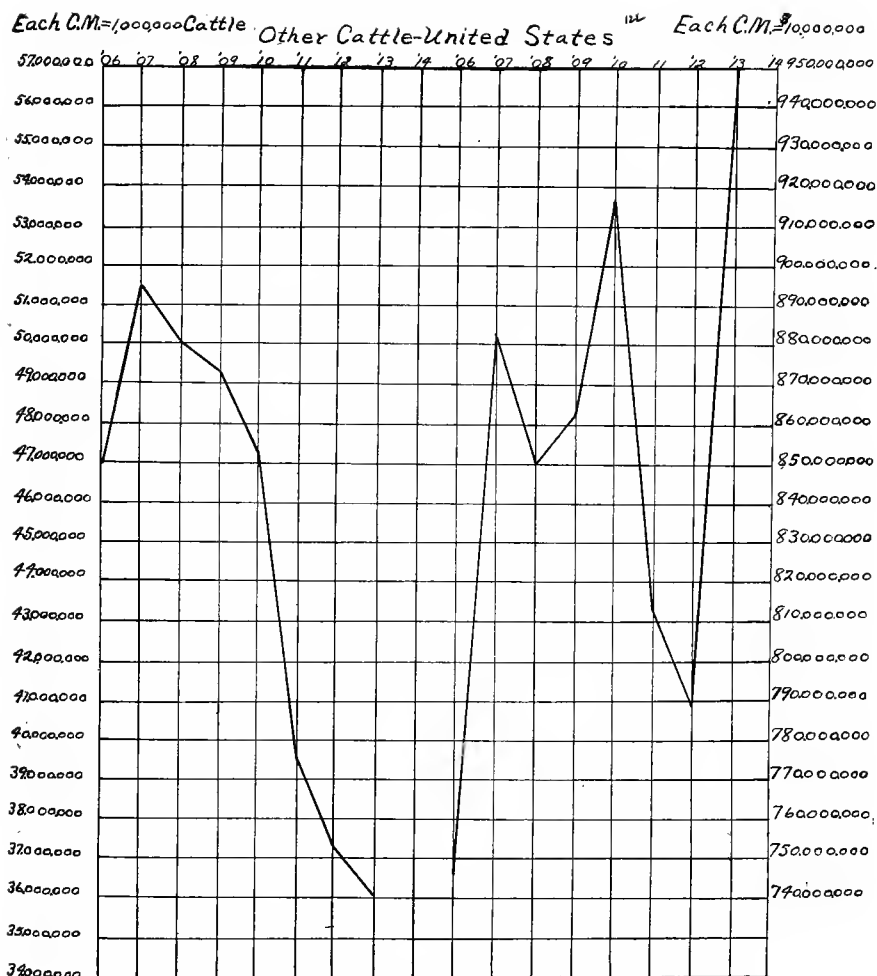


PLATE XVII.

Diagram showing the number (left) and farm value (right) of other cattle in the United States from January 1, 1906, to January 1, 1913.
(Data from the U. S. Dept. of Agriculture)

